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Patient-Reported Functional Outcomes and Quality of Life Following Free Fibula Flap Reconstruction After Mandibular Resection for Oral Cancer: A Cross-Sectional Study

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Abstract

Introduction: Mandibular resection for oral cancer followed by free fibula flap (FFF) reconstruction can impair oral function and quality of life. Patient-reported outcomes provide important information beyond clinical measures. We aimed to describe patient-reported functional outcomes and health-related quality of life using the University of Washington Quality of Life Questionnaire version 4 (UW-QOL v4) after FFF reconstruction for mandibular defects in patients with oral cancer.

Materials and methods: This hospital-based cross-sectional study enrolled 70 patients who underwent mandibular resection and FFF reconstruction. Demographic and clinical data were extracted from the patient records. The patients completed the UW-QOL v4. The primary outcomes were the chewing, swallowing, and speech domain scores. Secondary outcomes included the remaining domains, composite scores, and global quality of life ratings. Descriptive statistics, Spearman correlations, Mann-Whitney U tests, and Kruskal-Wallis tests were used.

Results: The mean age was 59.83 ± 9.73 years, and 50 (71.4%) were males. The median follow-up period was 17 months. The mean composite score was 57.40 ± 5.91. The highest mean domain scores were mood (73.36 ± 11.53) and appearance (70.13 ± 6.56). The lowest scores were for chewing (33.13 ± 16.11) and saliva (47.83 ± 8.92). The mean swallowing and speech scores were 52.81 ± 9.01 and 55.26 ± 10.32, respectively. No significant differences were observed by tumor stage (T) or sex.

Conclusion: Patients following mandibular resection and FFF reconstruction demonstrated moderately preserved overall quality of life, with persistent limitations in chewing and salivary function. These findings highlight the importance of routine patient-reported outcome assessment and multidisciplinary supportive care, particularly dental rehabilitation and management of xerostomia and swallowing difficulties.

Categories: Dentistry
Keywords: free tissue flaps, mandibular neoplasms, mandibular reconstruction, quality of life, questionnaires, surveys

Introduction

Oral cancer frequently requires mandibular resection in order to achieve adequate surgical margins and oncological control. Such resections disrupt mandibular continuity and can substantially impair oral function (mastication, deglutition, and speech) and facial esthetics [1,2]. Immediate reconstruction with a free fibula flap (FFF) has become the preferred method for segmental mandibular defects because of its reliable vascular pedicle, sufficient bone stock to support osseointegrated implants, and generally acceptable donor-site morbidity [3,4].

Despite technical advances in microsurgical reconstruction, many patients experience an incomplete functional recovery. Therefore, patient-reported outcomes have become important complementary measures of treatment success, beyond survival and clinician-assessed metrics [5]. The University of Washington Quality of Life Questionnaire version 4 (UW-QOL v4) is a brief disease-specific instrument that is widely used in head and neck oncology. It evaluates 12 domains (pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder, taste, saliva, mood, and anxiety) and includes separate global quality of life items [6,7].

Despite the widespread adoption of FFF reconstruction, systematic evidence indicates that validated tools for assessing functional and aesthetic outcomes remain inconsistently applied, and data on long-term patient-reported quality of life are still limited [8]. A recent study has further shown that chewing impairment is the strongest determinant of reduced quality of life after FFF mandibular reconstruction, with additional negative effects from radiotherapy, larger defects, and freehand techniques [9]. These findings highlight the need for focused evaluation of patient-reported oral functional domains in the intermediate-term period after reconstruction.

Assessment during the intermediate postoperative period is important because functional recovery following mandibular reconstruction extends beyond initial surgical healing. During this period, patients undergo adaptation to the reconstructed mandible and may experience changes in chewing, swallowing, and speech as a result of tissue healing, neuromuscular adjustment, adjuvant treatment, and dental or prosthetic rehabilitation. Evaluation at this stage therefore provides insight into functional outcomes and persistent limitations after the immediate postoperative phase, although it does not necessarily represent complete or final recovery. The primary aim of this hospital-based cross-sectional study was to assess patient-reported functional outcomes, particularly chewing, swallowing, and speech, among patients who had undergone mandibular resection for oral cancer, followed by FFF reconstruction, using the UW-QOL v4. Secondary objectives were to describe the remaining quality-of-life domain scores and composite score and to explore differences in functional domain and composite scores according to sex and tumor T stage.

Materials And Methods

Study design and setting

A hospital-based cross-sectional observational study was conducted among eligible patients who were identified from institutional records and contacted to complete a structured questionnaire. The study was performed at RKDF Dental College and Research Centre, Bhopal, India, from February 2025 to April 2026. This study was designed primarily to describe functional outcomes and quality of life, and secondary subgroup comparisons were considered exploratory. The study protocol was reviewed and approved by the Institutional Ethics Committee of the college before commencement of data collection (RKDF/DC/2025/SS-015). All participants were informed about the study objectives, voluntary nature of participation, and confidential handling of data. Written informed consent was obtained from each participant.

Study population and eligibility criteria

The study population comprised patients surgically treated for oral cancer who underwent mandibular resection and immediate reconstruction using a FFF. Reconstruction was performed during the same operative session as mandibular resection when restoration of the resulting mandibular defect was considered necessary. The selection of FFF was based on the clinical and reconstructive requirements documented in the patient records, including the extent and location of the mandibular defect and the need to restore mandibular continuity and contour. The vascularized fibular bone also provides the potential for subsequent dental implant-supported rehabilitation. All included patients underwent immediate reconstruction; patients who underwent delayed reconstruction were not included. Consecutive sampling was employed during the recruitment and data collection period from February 2025 to April 2026.

A total of 98 eligible patients were approached for participation in the study. Of these, 28 declined participation and did not provide informed consent. The remaining 70 patients provided written informed consent and were included in the study. The participation rate was 71.4%. Patients were eligible if they were aged 18 years or older; had histopathologically confirmed oral cancer; had undergone previous mandibular resection followed by FFF reconstruction; had a minimum follow-up of seven months after reconstruction; had available clinical records documenting the primary tumor site, histological diagnosis, tumor stage, and type of mandibular resection; were able and willing to provide informed consent; and completed the questionnaire independently or with appropriate assistance. Patients were excluded if they had undergone mandibular reconstruction using a flap other than an FFF, had incomplete clinical records that prevented the confirmation of eligibility, were unable to provide reliable questionnaire responses, declined to participate, or had a follow-up duration of less than seven months. Patients with recurrent or persistent disease were excluded from the study to focus on the quality of life following completed primary treatment.

Data collection and clinical variables

Demographic and clinical information was obtained from institutional records and confirmed by the participants, where necessary. The variables recorded included age, sex, primary tumor site, type of mandibular resection (segmental, marginal, or hemimandibulectomy), tumor (T) stage, histological diagnosis, and follow-up duration. The follow-up duration was calculated in months from the date of reconstruction to the date of questionnaire completion. Where available, additional treatment-related information, including postoperative radiotherapy and dental rehabilitation status (defined as the documented presence or absence of prosthetic or implant-supported rehabilitation at the time of assessment), was recorded. However, documentation of these variables was incomplete and was not consistently available for all participants. Therefore, these variables were not included in the statistical comparisons, and missing information was not interpreted as absence of treatment.

Assessment of patient-reported outcomes

Patient-reported outcomes were assessed using the UW-QOL v4 [6,7]. This instrument evaluates 12 domains relevant to patients with head and neck cancer, namely, pain, appearance, activity, recreation, swallowing, chewing, speech, shoulder function, taste, saliva, mood, and anxiety. It also includes a separate global quality of life assessment and questions concerning the relative importance of different quality of life domains. The chewing, swallowing, and speech domains were identified a priori as the principal functional outcomes because they directly reflect important aspects of oral function after mandibular resection and reconstruction. All 12 domain scores were retained for descriptive analysis.

The UW-QOL v4 questionnaire was administered using a standardized approach. The original English version was used for all participants, and no translated language versions were administered. Patients completed the questionnaire independently or, when required because of literacy or visual difficulties, with assistance from trained study staff. Assistance was limited to reading the questions and response options aloud and recording the participants' selected responses. Staff members did not interpret questions beyond their intended meaning, suggest responses, or otherwise influence participants' answers.

Domain scores were transformed into a 0-100 scale, with higher scores representing better function or quality of life and lower scores representing greater impairment. The global quality of life response was analyzed separately from the 12 domain scores. A composite score was calculated as the arithmetic mean of the 12 domain scores for each participant when required responses were available. The composite score was interpreted as a supplementary summary of domain-based quality of life and not as a replacement for the individual domain scores or the separate global quality of life rating. Questionnaire completion and missing responses were handled according to a prespecified scoring procedure.

Study outcomes

The primary outcome was the UW-QOL v4 scores for chewing, swallowing, and speech. These outcomes were summarized to describe the distribution and severity of patient-reported functional difficulties after FFF reconstruction. Secondary outcomes included scores for the remaining UW-QOL v4 domains, the composite mean of the 12 domain scores, and separate global quality of life ratings. Exploratory analyses examined whether functional outcomes and quality of life scores differed according to sex and tumor (T) stage and whether they were associated with age and duration of follow-up.

Sample size calculation

The sample size was estimated for the primary outcome, the mean UW-QOL v4 composite score, using the following formula:

$$n = \frac{Z^2 \cdot SD^2}{d^2} \label{eq:samplesize}$$

Based on a previously reported mean composite score standard deviation of 6.0 [3], a 95% confidence level ($Z = 1.96$), and absolute precision of 1.5 points, the minimum required sample size was 62 participants. Allowing for a 10% non-response or incomplete questionnaire rate, the final target sample size was 69 participants. Seventy participants (rounded figure) were included in this study.

Statistical analysis

Statistical analyses were performed using Statistical Product and Service Solutions (SPSS, version 26.0; IBM SPSS Statistics for Windows, Armonk, NY). Categorical variables are summarized as frequencies and percentages, while continuous variables are expressed as mean ± standard deviation or median and interquartile range, as appropriate. All 12 UW-QOL v4 domains, composite scores, and global quality-of-life scores were summarized descriptively. Differences between two independent groups were evaluated using the Mann-Whitney U test, whereas comparisons across tumor T stages were performed using the Kruskal-Wallis test. Two-sided p-values < 0.05 were considered statistically significant.

Results

All 12 UW-QOL v4 domain responses were available for the 70 participants; therefore, no domain-level missing data were encountered, and no imputation was required. The composite score was calculated as the arithmetic mean of the 12 domain scores for each participant. The mean age was 59.83 ± 9.73 years, and 50 (71.4%) were males. The most common primary sites were the buccal mucosa/gingivobuccal sulcus. Segmental mandibulectomy was performed in 45 patients (64.3%), and T4 disease was present in 32 patients (45.7%). Conventional squamous cell carcinoma was diagnosed in 66 (94.3%) patients. The median follow-up period was 17 (IQR: 14-19) months (Table *1*).

Variable	Category/statistic	Value (n = 70)
Age (years)	Mean ± SD	59.83 ± 9.73
	Median (IQR)	60.50 (52.00-65.75)
Sex, n (%)	Male	50 (71.4%)
	Female	20 (28.6%)
Primary tumor site, n (%)	Oral tongue/floor of mouth	18 (25.7%)
	Buccal mucosa/gingivobuccal sulcus	22 (31.4%)
	Lower gingiva/alveolus	12 (17.1%)
	Retromolar trigone	12 (17.1%)
	Other oral cavity	6 (8.6%)
Mandibular resection, n (%)	Segmental mandibulectomy	45 (64.3%)
	Marginal mandibulectomy	9 (12.9%)
	Hemimandibulectomy	16 (22.9%)
T stage, n (%)	T1	7 (10.0%)
	T2	15 (21.4%)
	T3	16 (22.9%)
	T4	32 (45.7%)
Histological diagnosis, n (%)	Conventional squamous cell carcinoma	66 (94.3%)
	Verrucous squamous cell carcinoma	2 (2.9%)
	Other carcinoma	2 (2.9%)
Follow-up time (months)	Mean ± SD	16.74 ± 4.10
	Median (IQR)	17 (14-19)
	Range	7-24

TABLE 1: Demographic and clinical characteristics of the study participants.

Continuous variables are presented as mean ± standard deviation (SD), median (interquartile range (IQR)), or range, as indicated; categorical variables are presented as numbers and percentages. Percentages are calculated using the total study sample (N = 70).

T: Tumor stage

The mean composite UW-QOL v4 score was 57.40 ± 5.91 (median: 57, IQR: 53-61). The highest mean scores were observed for mood (73.36 ± 11.53) and appearance (70.13 ± 6.56). The lowest scores were recorded for chewing (33.13 ± 16.11) and saliva (47.83 ± 8.92). The mean scores for the primary functional domains were 33.13 ± 16.11 for chewing, 52.81 ± 9.01 for swallowing, and 55.26 ± 10.32 for speech (Table *2*).

Domain	Mean ± SD	Median (IQR)	Range
Pain	67.38 ± 7.52	67 (61-72)	48-81
Appearance	70.13 ± 6.56	70 (65-74)	55-85
Activity	56.47 ± 9.10	56 (51-62)	31-73
Recreation	60.09 ± 8.12	59 (54-65)	40-79
Swallowing	52.81 ± 9.01	52 (46-59)	30-71
Chewing	33.13 ± 16.11	34 (23-44)	0-71
Speech	55.26 ± 10.32	53 (47-63)	35-76
Shoulder	65.92 ± 7.13	65 (60-70)	45-80
Taste	55.64 ± 6.03	55 (51-61)	43-69
Saliva	47.83 ± 8.92	47 (41-53)	28-64
Mood	73.36 ± 11.53	74 (65-80)	36-97
Anxiety	50.78 ± 14.33	50 (39-60)	23-86
Composite (mean of 12 domains)	57.40 ± 5.91	57 (53-61)	45-69

TABLE 2: Descriptive statistics of University of Washington Quality of Life Questionnaire version 4 (UW-QOL v4) domain and composite scores (N = 70).

Domain and composite scores are presented as mean ± standard deviation (SD), median (interquartile range (IQR)), and range. The composite score is the mean of the 12 UW-QOL v4 domains. Higher scores should be interpreted according to the scoring direction specified for the UW-QOL v4 instrument.

No statistically significant differences in chewing, swallowing, speech, or composite scores were found across T stages or between males and females. The effect sizes were negligible for all comparisons (Tables 3-4). These comparisons were exploratory and should be interpreted cautiously because of the relatively small numbers of participants within individual subgroups.

Outcome	T 1 stage n = 7, median (IQR)	T 2 stage n = 15, median (IQR)	T 3 stage n = 16, median (IQR)	T 4 stage n = 32, median (IQR)	Kruskal-Wallis H	p-value	Effect size (η^2)
Chewing	26 (23-49)	32 (18-41)	36 (25-49)	34 (19-43)	1.562	0.668	0.00
Swallowing	56 (44-61)	55 (45-59)	51 (48-58)	50 (46-57)	0.727	0.867	0.00
Speech	50 (43-53)	62 (52-66)	57 (49-63)	50 (44-59)	7.382	0.061	0.07
UW-QOL v4 composite mean	57 (48-61)	59 (55-62)	57 (53-62)	57 (53-60)	1.019	0.797	0.00

TABLE 3: Comparison of key functional domain and composite scores across tumor T stages (N = 70).

Values are presented as median (interquartile range (IQR)) for each T stage. Differences across the four independent T-stage groups were assessed using the Kruskal-Wallis test; the H statistic, p-value, and reported effect size are shown. A two-sided $p < 0.05$ was considered statistically significant; none of the comparisons reached this threshold.

T stage: primary tumor (T) stage; UW-QOL v4: University of Washington Quality of Life Questionnaire version 4; η^2: eta-squared

Outcome	Male n = 50, median (IQR)	Female n = 20, median (IQR)	Mann-Whitney U	p-value	Effect size (r)
Chewing	33 (23-44)	34 (24-44)	491.0	0.912	-0.018
Swallowing	51 (46-59)	52 (47-58)	460.0	0.608	-0.08
Speech	53 (45-62)	56 (50-63)	425.5	0.336	-0.149
UW-QOL v4 composite mean	58 (52-61)	56 (54-63)	487.0	0.871	-0.026

TABLE 4: Comparison of key functional domain and composite scores between male and female participants.

Values are presented as median (interquartile range (IQR)) for males and females. Differences between the two independent groups were assessed using the Mann-Whitney U test; the U statistic, p-value, and reported effect size are shown. A two-sided $p < 0.05$ was considered statistically significant; none of the comparisons reached this threshold.

UW-QOL v4: University of Washington Quality of Life Questionnaire version 4; r: rank biserial

The quality of life ratings during the past seven days were compared between male (n = 50) and female (n = 20) participants using the Fisher-Freeman-Halton exact test, an extension of Fisher's exact test for contingency tables larger than 2 × 2. Overall, "Fair" was the most frequently reported rating, followed by "Good" and "Poor". The distribution of quality of life ratings did not differ significantly between males and females ($p = 0.444$). Thus, no statistically significant association was observed between sex and global quality-of-life rating in this sample (Table 5).

Category	Total n = 70, n (%)	Male n = 50, n (%)	Female n = 20, n (%)	p-value
Outstanding	1 (1.43)	1 (1.43)	0 (0.00)	0.444
Very good	6 (8.57)	3 (4.29)	3 (4.29)	
Good	17 (24.29)	11 (15.71)	6 (8.57)	
Fair	24 (34.29)	20 (28.57)	4 (5.71)	
Poor	12 (17.14)	9 (12.86)	3 (4.29)	
Very poor	10 (14.29)	6 (8.57)	4 (5.71)	

TABLE 5: Global quality-of-life comparison between sex.

Data are presented as frequencies and percentages. The Fisher-Freeman-Halton exact test was used to calculate the p-value; $p < 0.05$ was considered statistically significant.

Discussion

This cross-sectional study described the patient-reported functional outcomes and health-related quality of life after mandibular resection and FFF reconstruction for oral cancer. The overall quality of life was moderately preserved at the intermediate follow-up; however, clear domain-specific impairments emerged, particularly in oral functions most directly affected by mandibular discontinuity and adjuvant treatment. These patterns align with prior reports using the UW-QOL v4 after similar reconstructions [8,9]. Chewing was found to be the most compromised condition. Segmental or hemimandibulectomy removes dentition-bearing bone and alters occlusal relationships, while soft-tissue scarring and limited mouth opening further restrict masticatory efficiency [10]. Even with a well-vascularized fibular flap that restores continuity, full recovery of the biting force and bolus preparation is uncommon without timely dental rehabilitation. Previous studies on mandibular reconstruction with a FFF have consistently identified chewing as one of the most impaired and often the lowest-scoring quality of life domains. This impairment has been associated with the loss of mandibular teeth and residual malocclusion, among other postoperative factors, rather than flap failure alone [8,11]. Clinically, this finding underscores the need for early prosthetic- or implant-supported rehabilitation and structured dietary counseling so that patients can maintain adequate nutrition while adapting to a soft or modified diet.

The salivary function was substantially reduced. Adjuvant radiotherapy, frequently required for advanced oral cancers, causes irreversible damage to the major and minor salivary glands, resulting in xerostomia and thick, sticky saliva [12]. These changes cause chewing and swallowing difficulties and increase the risk of dental caries and mucosal irritation. Multiple studies on head and neck cancer survivors have documented persistent salivary impairment after radiotherapy, independent of the reconstruction method [13,14]. Recognition of this problem supports the routine assessment of xerostomia and proactive measures, such as salivary substitutes, fluoride regimens, and, when feasible, intensity-modulated radiotherapy techniques that spare residual glandular tissue [15,16].

Swallowing and speech exhibit intermediate impairment. Although FFF reconstruction restores mandibular continuity and provides bone for reconstruction, functional recovery may remain incomplete because of the associated soft tissue resection, reduced tongue mobility, altered oral anatomy, and treatment-related fibrosis. Anterior mandibular defects may compromise lip competence and speech articulation. Studies have reported poorer patient-reported quality of life outcomes in patients with anterior resections, larger defects, and radiotherapy, whereas postoperative radiotherapy and extensive tongue resection have been associated with impaired swallowing function [9,17,18]. Early involvement of speech and language therapists, together with exercises that maintain tongue mobility and mouth opening, can mitigate progressive decline and should be integrated into the postoperative pathway.

In contrast, mood, appearance, and pain scores were relatively favorable. Successful FFF reconstruction can restore mandibular continuity and facial contour, support social reintegration, and improve overall quality of life. Studies on mandibular reconstruction using FFFs have reported relatively favorable scores for pain and mood, although the outcomes vary across patients and studies. Aesthetic and psychological outcomes may remain affected despite successful reconstruction, emphasizing that flap survival and oncologic clearance do not necessarily ensure complete functional or psychosocial recovery [3,19,20]. These better-preserved domains indicate that patients often adapt psychologically once the immediate threat of cancer is controlled; however, this should not obscure the ongoing functional burden.

Chewing, swallowing, and speech are important functional dimensions of quality of life following mandibular reconstruction. Among these domains, chewing was the most impaired in the present study, highlighting the persistent masticatory difficulties experienced by patients after mandibular resection and FFF reconstruction. Previous studies have similarly identified chewing as an important concern and one of the most affected functional domains following mandibular reconstruction [3,8]. These findings emphasize the clinical importance of multidisciplinary rehabilitation strategies targeting mastication, swallowing, and speech to address persistent functional limitations and potentially improve patients' quality of life.

No statistically significant differences in patient-reported functional outcomes were observed according to tumor T stage or sex in the present study. However, these findings should be interpreted cautiously because of the relatively small subgroup sizes, which may have limited the ability to detect clinically meaningful differences. The absence of statistical significance does not necessarily indicate that tumor stage or sex has no influence on postoperative functional outcomes. Larger multicenter studies may provide better insight into the potential relationships between patient characteristics, defect-related factors, adjuvant treatment, and quality of life following mandibular reconstruction [11,21].

The clinical implications of the present findings highlight the need for proactive, multidisciplinary rehabilitation. Preoperative counselling should set realistic expectations regarding persistent chewing and salivary difficulties. Postoperative pathways should prioritize early dental rehabilitation, xerostomia management, and speech and swallowing therapy [15,16,22]. Routine use of a brief instrument, such as the UW-QOL v4, can help identify patients whose functional scores trigger further intervention and allow monitoring of progress over time [6,7]. Limitations include the cross-sectional design, which precludes assessment of change from baseline or the trajectory of recovery; the single-center setting and modest sample size, which limits generalizability; incomplete data on radiotherapy dose and dental rehabilitation status in some cases; and the exploratory nature of subgroup comparisons. The retrospective nature of clinical record review resulted in incomplete documentation of postoperative radiotherapy and dental rehabilitation, limiting the assessment of their potential influence on patient-reported functional outcomes. Prospective longitudinal studies with standardized rehabilitation protocols and longer follow-up periods are required to determine the interventions that most effectively improve the domains most affected after FFF reconstruction.

Conclusions

This study demonstrated moderately preserved overall quality of life among patients who underwent mandibular resection followed by FFF reconstruction for oral cancer. However, substantial impairments were reported in chewing and salivary function, while swallowing and speech were affected to a lesser extent. Mood, appearance, and pain were relatively better preserved. These findings highlight the importance of routine patient-reported outcome assessment and consideration of multidisciplinary supportive care, including dental rehabilitation, xerostomia management, and speech and swallowing therapy. However, the cross-sectional design and incomplete documentation of treatment-related factors limit the interpretation of determinants of functional outcomes. Prospective longitudinal studies are needed to evaluate functional

recovery and the effectiveness of targeted rehabilitation strategies.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

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Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. Institutional Ethical Committee of RKDF Dental College, Bhopal issued approval RKDF/DC/2025/SS-015. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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