

# Study of Quality of Life in Patients with Soft Tissue Reconstruction Following Mandibulectomy

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## Abstract

**Purpose** To study the effect of mandibulectomy with soft tissue reconstruction on quality of life (QOL) and functions of speech and swallowing.

**Methodology** Quality of life of 66 patients was evaluated by using EORTC QLQ-C30 and EORTC-HN35 questionnaires. Speech was evaluated objectively by Dr. Speech software version 4 and subjectively by a single speech therapist along with swallowing. Patients were evaluated preoperatively and 6 months after treatment.

**Results** Out of 66 patients, 57 followed up postoperatively. Comparison of preoperative and postoperative QOL, speech, and swallowing was done by using paired ‘t’ test or Wilcoxon signed-rank test as per distribution. When evaluated by EORTC QLQ-C30 and EORTC-HN35, statistically significant difference was found in the domains of physical function, fatigue, nausea-vomiting, dyspnea and appetite loss, pain, nutrition, swallowing speech and dry mouth. Significant difference was found in speech (maximum intensity) and most of the domains of swallowing.

**Conclusion** In EORTC QLQ-C30 questionnaire, all functional scales showed deterioration with maximum in physical function. Symptom scales showed worsening but significant improvement was found in pain when evaluated by EORTC-HN35. However, the global health status/QL was found to be improved marginally.

**Keywords** Quality of life · Mandibulectomy · Mandibular tumors

## Introduction

The reconstruction following resection of the mandible is a challenge and should provide a stable arch to occlude with the maxillary arch restoring function, esthetics and good quality of life [1–3]. Segmental resection with soft tissue reconstruction leads to deviation of the segment toward to the resected side. The range of motion of the mandible in lateral and protrusive movement is affected along with impairment of occlusion and reduced proprioception [4, 5]. Uncoordinated masticatory movements may result in dental or soft tissue trauma, including severe lip or tongue lacerations [6]. The free fibular flap is now considered the gold standard for mandibular reconstruction. However, in patients with multiple comorbidities, lengthy procedures may be less optimal and pedicled flaps, with specific modifications, can yield reasonable outcomes [7].

This study was aimed to assess the quality of life (QOL) and functional status of patients before and after segmental resection of the mandible with soft tissue reconstruction.

## Methodology

In this study, 100 consecutive patients who were planned to undergo mandibulectomy were screened, out of which 66 consenting patients were accrued for the study. The study was initiated after approval from Human Ethics Committee of Tata Memorial Hospital, Mumbai (Project No. 757). The inclusion criteria were: patients planned for mandibular segmental resection where the continuity of the mandible

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must be disrupted after segmental resection. While exclusion criteria were edentulous patients, patients having neoplasm in other areas of the body, patients who have undergone maxillary resection, orbital enucleation, midfacial resection, craniofacial resection along with mandibulectomy, and patients in whom discontinuity of the mandible is repaired with osseous reconstruction.

All these patients were evaluated preoperatively for the quality of life by using European Organization of Research and Treatment of Cancer quality of life (EORTC QLQ-C30) [8] and EORTC-HN35 questionnaire. Dr. Speech Software version 4 was used for objective evaluation of speech. Subjective evaluation of speech and swallowing was done by a single speech therapist. All the patients were again evaluated for QOL and speech after 6 months of completion of surgery and adjuvant treatments, i.e., radiation therapy and/or chemotherapy.

### Quality of Life Evaluation

EORTC QLQ-C30 [8] and EORTC-HN35 questionnaires were used to evaluate QOL in this study. The EORTC QLQ-HN35 is designed to be used together with the core QLQ-C30. The scores are transformed into 0–100 scales, with a high score implying a high level of symptoms or problems. These questionnaires are translated and validated in Indian vernacular languages Hindi and Marathi by Chaukar et al. [9].

### Speech Evaluation

The speech was evaluated at different phases of study by a single speech therapist. Patient's speech was assessed with the help of Dr. Speech Software version 4 (Tiger DRS, Inc., Seattle). It analyzes the following voice parameters, fundamental frequency (Hz), frequency range (Hz), intensity [(dB)-decibel], maximum phonation time (MPT) secs, perturbation parameters such as jitter (pitch perturbation) and shimmer (amplitude perturbation) [10].

Subjective evaluation of speech and swallowing was done by using a questionnaire designed by Dr. Bachher [11], and analysis was done by a single speech therapist at both the time points.

### Statistical Analysis

The data are presented as mean  $\pm$  SD, median (IQR), or frequency (percentage). A paired comparison was done using paired t test or Wilcoxon signed-rank test as per distribution. The level of significance was targeted at 5%. IBM SPSS version 24 was used for data management purpose.

## Results

Total of 66 patients were enrolled for the study out of which 57 patients (44 males/13 females; mean age 51 years; age range 33–72) (Table 1) came for follow-up after 6 months of completion of definitive treatment (86.36% follow-up). In most of the patients (55/57), final histopathological report was squamous cell carcinoma (SCC), one patient, each of adenoid cystic carcinoma of the submandibular salivary gland and verrucous hyperplasia. All these patients had undergone soft tissue closure without bone grafting. Various soft tissue grafting procedures were done in these patients like primary closure with the split thickness skin graft (3), anteromedial thigh flap (1), free radial forearm flap (1), pectoralis major myocutaneous flap (PMMC) (50), and PMMC with deltopectoral flap (2).

As per TNM staging, 35 patients were of T4 stage, 7 of T3, 13 of T2, and two patients of T1 stage. Neck dissection was done in 45 patients, and in 29 patients nodes were positive for malignancy. Out of 57 patients, 24 patients received radiotherapy (RT) and another 22 patients

**Table 1** Patient characteristics

Baseline characteristics ( <i>n</i> = 57)	Mean (range) or number (%)
Age (years)	51 (33–72)
Sex	
Male	44 (77.2%)
Female	13 (22.8%)
Histopathological report	
Squamous cell carcinoma	55
Adenoid cystic carcinoma	1
Verrucous hyperplasia	1
Postoperative radiotherapy	24 (42.10%)
Concurrent chemoradiotherapy	22 (38.6%)
T status	
T1	2
T2	12
T3	7
T4	35
N status	
N0	29
N1	17
N2	11
Type of flap used	
PMMC	50
PMMC with deltopectoral	2
Split thickness skin	3
Anteromedial thigh free flap	1
Radial forearm	1

received RT along with concurrent chemotherapy postoperatively (CTRT).

### Quality of Life Assessment

#### EORTC QLQ-C30 (Table 2, Fig. 1)

*Functional scales* Mean scores of all functional scales were low postoperatively with significant difference observed in physical function.

*Global QL* was reduced postoperatively, however, not statistically significant.

*Symptom scale* Mean scores of all symptom scales were higher postoperatively with the significant difference found in fatigue, nausea-vomiting, dyspnea, and appetite loss.

#### EORTC-HN35 (Table 3, Fig. 2)

*Symptom scale* All symptoms except pain, nutrition, and feeding tube showed an increase in mean scores postoperatively. A significant difference was found in the domains of pain, swallowing, speech, dry mouth, and nutrition.

**Table 2** Analysis of pre- and post-QOL scores for EORTC QLQ-C30

	Pre-op scores	Post-op scores	Sig. ( <i>p</i> value)
PF	87.3684	82.5731	<b>.018</b>
RF	87.7193	82.7485	.108
EF	75.2924	74.7076	.689
CF	87.4269	84.5029	.339
SF	80.4094	78.0702	.450
QL	61.7560	67.2515	.186
FA	21.2476	30.7992	<b>.009</b>
NV	4.6784	13.1579	<b>.009</b>
PA	23.3918	26.9006	.457
DY	6.4327	16.3743	<b>.004</b>
SL	13.4503	21.0526	.116
AP	15.2047	28.0702	<b>.007</b>
CO	13.4503	13.4503	.955
DI	4.0936	7.0175	.371
FI	36.2573	36.8421	.917

PF physical functioning, RF role functioning, EF emotional functioning, CF cognitive functioning, SF social functioning, QL global health status/QoL, FA fatigue, NV nausea and vomiting, PA pain, DY dyspnoea, SL insomnia, AP appetite loss, CO constipation, DI diarrhea, FI financial difficulties

Bold value indicates  $p < 0.05$  is considered as statistically significant

### Speech

In objective analysis (Table 4) of speech, the difference was found only in maximum intensity, while subjective analysis (Table 5) of speech showed improvement in class of errors. There was improvement in taste of food and swallowing liquids.

### Discussion

#### Quality of Life

In EORTC QLQ-C30, the mean postoperative scores for the all five functional scales, i.e., physical functioning, role functioning, emotional functioning, cognitive functioning, social functioning were lesser than the mean of preoperative scores. Physical function scale was statistically significant ( $p = 0.018$ ) indicating betterment in physical function. The difference in pre-op and post-op functional mean score ranged between 1 to 5 points. The mean postoperative score for global quality of life was higher than the preoperative score. (Table 1, Fig. 1).

These findings are in similar to Becker et al. [12] and Schliephake et al. [13] who reported lower values for the role of functioning and financial difficulties in discontinuity resection group. Schliephake et al. [13] also showed that surgical treatment of oral cancer of the floor of the mouth led to a temporary deterioration of physical function and role function 3 months after surgery. These changes were accompanied by a significant decrease in oral function with reduced body image, ability, and willingness for social contact. The levels of these scores improved until the end of the first year after treatment.

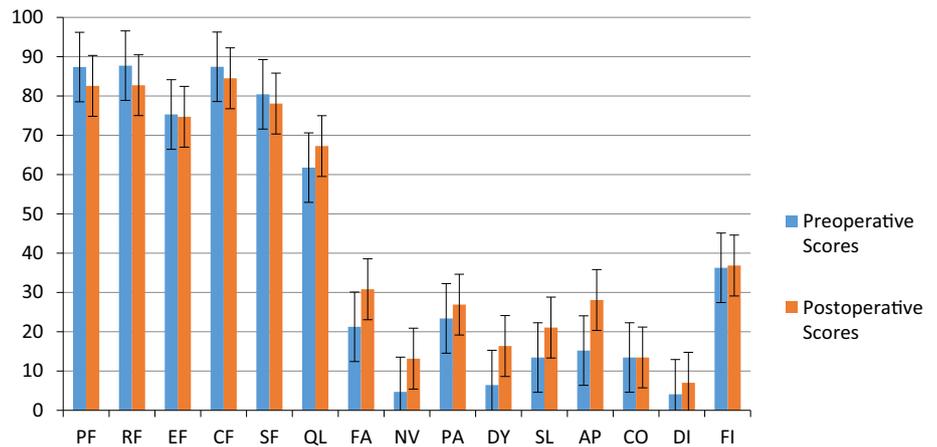
Higher scores were observed in all the symptom scales postoperatively as compared to preoperative, representing high level of problems. Statistically significant results were observed in the domains of fatigue, nausea-vomiting, dyspnoea, and appetite loss. These general symptoms are affected by major surgeries and further worsened by postoperative radiotherapy.

In EORTC-HN35, low mean scores were observed postoperatively only in pain, nutrition, feeding tube. Statistically significant differences were seen in the domains of pain and nutrition.

Low scores indicate fewer symptoms postoperatively. Postoperative pain was significantly low as patients were disease free. Also in this period, patients were dependent on feeding tube improving the nutritional status of these patients.

In all other multi-item and single-item scales, the postoperative mean scores were more than preoperative mean scores indicating worsening of symptoms after surgical

**Fig. 1** EORTC QLQ-C30: preoperative and postoperative quality of life



**Table 3** Analysis of pre- and post-QOL scores EORTC QOL-HN35

	Pre-op	Post-op	Sig. ( <i>p</i> value)
HNPA	31.4815	23.3918	<b>.042</b>
HNSW	8.7719	20.1754	<b>.001</b>
HNSE	9.6491	15.7895	.059
HNSP	11.5010	21.2476	<b>.001</b>
HNSO	19.5906	22.2222	.433
HNSC	10.8772	13.5673	.377
HNSX	9.3567	15.4545	.092
HNTE	29.1667	33.9181	.343
HNOM	29.2398	36.8421	.132
HNDR	17.5439	37.5000	<b>.003</b>
HNSS	17.8571	29.2398	.052
HNCO	10.5263	15.2047	.170
HNFI	22.8070	28.0702	.811
HNPK	42.1053	54.3860	.178
HNNU	60.7143	43.8596	<b>.018</b>
HNFE	53.5714	52.6316	.835
HNWL	39.2857	42.1053	.715
HNWG	58.9286	59.6491	1.000

Abbreviations: HNPA: Pain, HNSW: Swallowing, HNSE: Senses problems, HNSO: Trouble with social eating, HNSC: Trouble with social contact, HNSX: Less sexuality, HNTE: Teeth, HNOM: Opening mouth, HNDR: Dry mouth, HNSS: Sticky saliva, HNCO: Coughing, HNFI: Felt ill, HNPk: Pain killers, HNNU: Nutritional supplements, HNFE: Feeding tube, HNWL: Weight loss, HNWG: Weight gain

Bold value indicates  $p < 0.05$  is considered as statistically significant

treatment for cancer of the mandible. The difference was statistically significant for swallowing, speech, and dry mouth. In this study, 80% of the patients were radiated, the salivation was reduced causing problems in speech and swallowing.

Radiotherapy involving major and minor salivary glands affects salivary flow. Xerostomia-related symptoms were

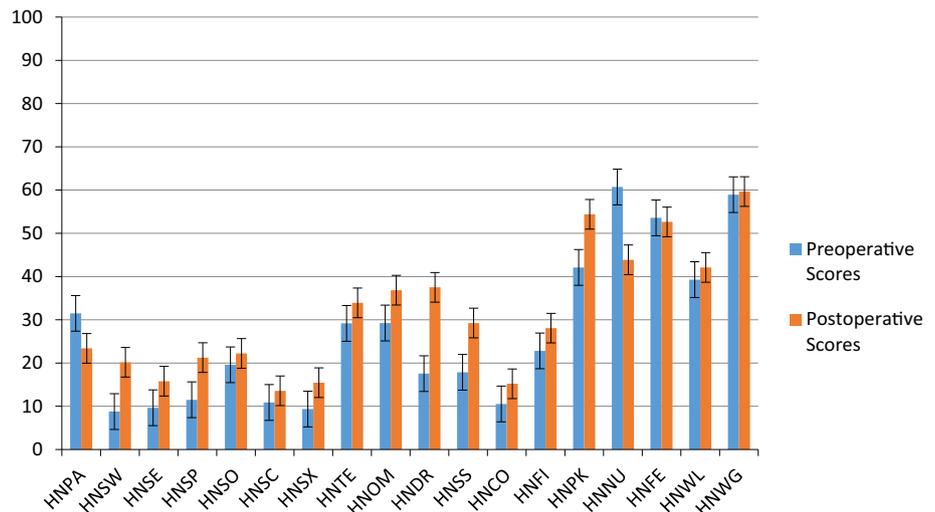
usually cited as the most prevalent complications in head neck cancer survivors. Xerostomia has been found to significantly correlate with mean dose to the parotid glands and the minor salivary glands in the oral cavity [14]. Kakoei et al. [15] have shown that one-score increase in xerostomia led to 1.65% decrease in QOL mean score. Swallowing also gets affected with radiotherapy. Speech is mainly affected due to lack of control on the tongue and mandibular deviation. Rinkel et al [16] reported a high prevalence of patients with swallowing (79%) and speech (55%) problems after chemoradiation for advanced head and neck cancer. In our study, 22 out of 57 patients received CTRT, which is also additional factor hampering swallowing apart from mandibular deviation.

In a long-term study of 36 months, de Graeff et al. [17] prospectively evaluated the changes of health-related quality of life for 107 head and neck cancer patients treated by surgery and/or RT by using the EORTC QLQ-C30 and QLQ-HN35 questionnaire before treatment, and 6, 12, 24, and 36 months later. There was limited deterioration of physical and role functioning and related symptoms at 6 months, with improvement thereafter. After 36 months only, physical functioning, taste/smell, dry mouth, and sticky saliva were significantly worse, compared with baseline. In this study, 46% of patients were of oral cavity cancer and more than half patients (55%) were radiated; however, the number of participants who had undergone mandibulectomy was not specified.

Borggreven et al. [18] had stated that in major surgeries involving soft tissue reconstruction, swallowing function was impaired for 6 months and persisted for 12 months. In our study, the follow-up period was only for 6 months during which swallowing was significantly affected.

All other symptom scales in HN35 showed deterioration of symptoms; however, they are not statistically significant.

**Fig. 2** EORTC QOL-HN35: pre-op and post-op quality of life



**Table 4** Analysis of speech (objective method) by using Dr. Speech software

Ave_F0	178.6089	176.5549	.627
Max_F0	259.5139	250.7668	.371
Min_F0	115.2219	107.8126	.105
Ave_Int	26.2002	26.7235	.370
Max_Int	50.3600	60.6414	<b>.043</b>
Min_Int	9.5400	9.5400	1.000
F0	146.8160	142.4670	.458
Jitter	3.8256	.2507	.977
Shimmer	1.1302	1.1937	.903
MPT	11.1825	10.8742	.880
s_z_Ratio	1.1544	1.7042	.535

Bold value indicates  $p < 0.05$  is considered as statistically significant

### Objective Evaluation of Speech

Statistically significant difference was noted in maximum intensity indicating patient's speech was loud enough while speaking postoperatively and near to normal individual's intensity levels. Patients may try to compensate the loss of articulation due to mandibular discontinuity defect by modulating speech intensity.

### Subjective Evaluation of Speech and Swallowing

Patients' speech, intelligibility, and articulation were affected postoperatively due to restricted mobility and movement of the tongue. Statistically significant results were found in questions related to consistency of food, type of food, food pocketing, the temperature of food, taste of food, and dietician counseling. Most patients could consume solid or semisolid diet (39/57); 20 patients could eat crumbly or grainy food 6 months after surgery. Food

pocketing persisted in 51 patients. The temperature of food affected their eating abilities. The taste was altered resulting in reduced desire to eat. Postoperatively patients had difficulty in swallowing without water. Severe xerostomia was noticed in four subjects, and mild xerostomia in 38 patients. Daily activity was also affected and was statistically significant. Namki et al. [19] studied the masticator efficiency before and after surgery in oral cancer patients. The study suggested that in marginal as well as in segmental mandibulectomy, the masticatory efficiency was reduced as compared to preoperative status. Discontinuation of the mandible leads patients to eat only foods that do not require a substantial amount of chewing.

Prosthetic methods, including intermaxillary fixation, mandibular-based guidance restorations, and palatal-based guidance restorations will reduce or minimize mandibular deviation [20–22].

All these patients received prosthetic rehabilitation by bite guide prosthesis. This prosthesis helps to control deviation of the unresected part of the jaw toward the resected side. This prosthesis was provided within 2 weeks of surgery and preferably before the start of radiotherapy.

This helped patients to control the jaw deviation and patients could consume semisolid food. Near about one-third of the patients (20/57) could resume solid food, while another one-third could consume semisolid food (19/57) and remaining could not bite at all but had to depend only on liquid diet.

In this study, side effects of radiotherapy overlaid those of mandibulectomy with soft tissue rehabilitation.

As 80% of our patients received radiotherapy, radiation-induced fibrosis, mucositis, xerostomia, dysphagia played a very important role in QOL and function. In order to know the exact effect of mandibulectomy with soft tissue rehabilitation on function and QOL, further studies are needed with stringent inclusion and exclusion criteria.

**Table 5** Analysis of speech and swallowing (subjective method) questionnaire filled by a single speech therapist

	Pre-op	Post-op	Sig. (2-tailed)
Intelligibility of speech	6.88	5.68	<b>.000</b>
Class of error in speech	9.98	8.88	<b>.001</b>
Movement	2.93	2.47	<b>.000</b>
Mobility of tongue	6.39	5.18	<b>.001</b>
Consistency of food	2.51	2.05	<b>.002</b>
Can you eat meat?	1.28	1.56	<b>.004</b>
Can you eat vegetables?	1.11	1.38	<b>.003</b>
Can you eat salad?	1.26	1.55	<b>.004</b>
Can you drink liquid	1.09	1.04	.180
Food needs to be swallowed by water	1.63	1.51	.201
Grainy / crumbly food	1.23	1.51	<b>.003</b>
Food pocketing	1.75	1.44	<b>.002</b>
Temperature of food	1.77	1.49	<b>.005</b>
Time taken for eating food	1.98	1.98	1.000
Social eating	1.13	1.26	.134
Taste of food	1.75	1.56	<b>.034</b>
Weight	1.21	1.34	.973
Dietitian consulting	1.91	1.71	<b>.027</b>
swallowing ability	6.70	6.09	<b>.015</b>
salivation	3.96	3.50	<b>.009</b>
Status of mandible	4.00	3.93	.180
Status of teeth	3.18	3.65	<b>.008</b>
Status of taste	3.93	3.73	<b>.048</b>
employment	2.98	2.70	.198
Daily activity	3.82	3.56	<b>.029</b>
Pain	3.65	3.91	.071
weight	5.69	5.75	.893

Abbreviations: Ave FO: average fundamental frequency, Max FO: maximum fundamental frequency, Min Fo: minimum fundamental frequency, Ave Int: average intensity, Max Int: maximum intensity, Min int: minimum intensity, FO: fundamental frequency, MPT: maximum phonation time  
 Bold value indicates  $p < 0.05$  is considered as statistically significant

**Conclusion**

The quality of life and functions of speech and swallowing gets affected in mandibulectomy reconstructed with soft tissue grafts. As compared with preoperative QOL, in EORTC questionnaire, all the functional scores were lower and symptoms scores were higher postoperatively. In EORTC-HN35, symptoms of pain, feeding tube, and nutrition only suggested improvement, while all other symptoms were worsened. Objective analysis of speech indicated an increase in maximum intensity, while subjective analysis demonstrated a significant difference between pre- and post-treatment speech and swallowing functions. General quality of life (QL) showed marginal improvement.

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**Compliance with Ethical Standards**

**Conflict of interest** All authors declare that they have no conflict of interest.

**Ethical Approval** All procedures performed in this study, involving human participants were in accordance with the ethical standards of the institutional research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

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