

# Effectiveness of Prosthetic Rehabilitation and Quality of Life of Older Edentulous Head and Neck Cancer Survivors Following Resection of the Maxilla. A Cross-sectional Study

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## Research Article

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# Abstract

## *Purpose*

To evaluate the effectiveness of the prosthetic rehabilitation, as well as the quality of life (QOL) of older edentulous maxillectomy patients.

## *Methods*

Effectiveness of the complete denture obturator prosthesis and QOL of 44 older patients who had resection of the maxilla and were restored with a definitive prosthesis that was in use for minimum 1 year was assessed using 3 instruments: European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Core Questionnaire (QLQ-C30), Head and Neck Cancer Module (QLQ-HN35), and Obturator Functioning Scale (OFS). Data analysis was performed by the one-way ANOVA on ranks, Spearman rank order correlation, and hierarchical multivariable rank regression at  $\alpha=.05$  level of significance.

## *Results*

Participants' gender ( $P<.001$ ), adjuvant treatment ( $P=.016$ ), surgical approach ( $P=.017$ ), size of the maxillary defect ( $P=.028$ ), participants' prosthetic history ( $P=.047$ ), and dental status of the mandible ( $P=.038$ ) were significantly related to the self-reported effectiveness of the obturator. Perceived functioning of the complete denture obturator prosthesis ( $P=.001$ ), participants' gender ( $P=.002$ ), the American Society of Anesthesiologists (ASA) physical status ( $P=.027$ ), and surgical approach ( $P=.039$ ) were significant predictors of QOL.

## *Conclusion*

Restoration of the edentulous maxillectomy defect is challenging. An effective definitive complete denture obturator appeared to be the strongest predictor for advanced quality of life in older maxillectomy patients. The physical status of the older participants significantly affected the overall QOL, but did not influence the self-reported functioning of the complete denture obturator prosthesis.

# Introduction

More than 50% of the new annually diagnosed worldwide head and neck cancer (HNC) cases occur in patients after the age of 65 [1]. As the world population ages, this digit is anticipated to increase; however there is less evidence regarding therapeutic strategies and treatment and rehabilitation guidelines for older patients, since they are generally underrepresented in clinical trials [2]. Furthermore, their additional chronic diseases could significantly affect not only the available treatment options, but also their survival probabilities and quality of life (QOL). Therefore it is of utmost importance the incorporation of comorbidity evaluation in the preoperative staging of patients with HNC  $\geq$  65 years old [3,4]. Previous studies support the use of the American Society of Anesthesiologists (ASA) physical status classification as a estimate of comorbidity evaluation in older surgical patients with HNC, since it retains its prognostic ability beyond the perioperative period, appears to be one of the most appropriate prognostic factors of postoperative morbidity, and is significantly related to the QOL following resection [4-6].

HNC and the consequent treatment can be life-changing, generating anxiety and distress. When the tumor involves the maxilla, a maxillectomy is required. The maxillectomy is a radical surgical resection involving the removal of a section or the total of the maxilla producing severe defects [7]. HNC survivors with maxillectomy in particular, face numerous functional and psychosocial post-therapeutic deficits, such as compromised speech and swallowing, defective appearance, disturbed body image, and elevated psychological disruption; since the life-preserving surgical resection leads

to critical physical deformities that have a profound effect on QOL [8]. Although vascularized free tissue transfers offer more reconstructive options, microvascular surgery is associated with higher morbidity, postoperative complications and worse functional outcomes in the elderly population, therefore prosthetic rehabilitation by means of an obturator prosthesis is still the most common treatment option [9]. Obturators could rehabilitate the patients with maxillectomy to a nearly normal degree of function, since they are able to reestablish oronasal separation, prevent food regurgitation to the nasal and sinus cavities, restore speech, mastication and swallowing, provide appropriate lip and cheek support, reduce facial deformity, address esthetic concerns, and restore their QOL. The restoration of the edentulous patient with maxillectomy could be considerably demanding, considering the lack of the important retentive elements of the remaining dentition. There is a number of studies evaluating the perceived functional prosthetic outcome, as well as the overall QOL in patients with resection limited to the maxilla; however all of them included both younger and older participants, with the majority being partially dentate following resection [10-13]. The authors couldn't identify any studies evaluating the challenges in the rehabilitation of the complete edentulous older maxillectomy patients. The aim of this survey was to evaluate the QOL of older edentulous maxillectomy patients in relation to their residual long term functional, social, esthetic, and psychological disabilities, and to assess the self-reported efficacy of the maxillofacial prosthetic outcome in restoring the resultant maxillectomy defect. The null hypothesis in the present study was: 1) QOL and perceived prosthesis functioning in older edentulous patients with maxillary resection were not affected by demographic and disease related characteristics, nor by the European Organization for Research and Treatment of Cancer (EORTC) cancer related functioning symptom measures (C-FSM) and head and neck cancer specific symptom measures (HNC-SM) and 2) the perceived functional prosthetic outcome did not affect the QOL of the older edentulous patients with resection of the maxilla.

## Materials And Methods

The study was performed at National and Kapodistrian University of Athens (NKUA) Evaggelismos General Hospital. The study protocol was approved by the ethics committee of NKUA (2015-268), in accordance with the Helsinki declaration and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines. The research protocol included 44 maxillary resection patients with a resultant edentulous maxillectomy defect that was restored by a maxillofacial prosthodontist (IIA), who fabricated the definitive complete denture obturator prostheses from 01-2015 to 12-2016. The inclusion criteria followed were: 1) age  $\geq$  65 years old, 2) history of maxillectomy, due to oncologic surgery, without surgical reconstruction and maxillofacial prosthetic rehabilitation, 3) Brown Class 2 vertical dimension of the maxillectomy defect, 4) Brown a, b, or c remaining horizontal palatal component [14] and 5) at the time of the interviews the participants were completely edentulous and were using a definitive complete denture obturator prosthesis for minimum a year; a maxillofacial prosthodontist evaluated the prostheses and they were in good condition, and did not require additional adjustments. The exclusion criteria were the following: 1) patients with history of mental and/or cognitive disorders, 2) surgical resection extending to other structures of the head and neck aside from the maxilla, 3) history of surgical reconstruction of the defect, 4) secondary closure of the defect by granulation tissue, 5) history of implant placement, 6) topical recurrence, and 7) ongoing oncologic therapy. QOL was assessed using the European Organization for Research and Treatment of Cancer (EORTC) Quality of Life Core Questionnaire (QLQ-C30) [15,16], and Head and Neck Cancer Module (QLQ-HN35) [17,18] that have both been validated in Greek [19,20]. The perceived functioning and effectiveness of the complete denture obturator prosthesis was evaluated by the Obturator Functioning Scale (OFS) [21] that was translated from English to Greek (forward translation) and then from Greek to English (backward translation) by 2 independent translators.

Due to the non-normal distribution of the obtained data, non parametric statistical methods were followed. The one-way analysis of variance (ANOVA) on ranks was employed to evaluate the relation between the demographic and disease related characteristics and QOL, as well as self-reported functional prosthetic outcome. The Spearman's rank correlation was used to investigate the interrelations between the calculated scores of QOL, OFS, C-FSM and HNC-SM. A hierarchical

multivariable rank regression was employed to recognize the most significant covariates of QOL and self reported effectiveness of the prosthesis, as well as to determine whether the perceived effectiveness of the prosthesis was a strong covariate of QOL. For the statistical analyses was used the SPSS software (IBM SPSS Statistics for Windows, v26.0; IBM Corp) at  $\alpha=.05$  level of significance.

## Results

The profile of the 44 participants is presented in Table 1, whereas in Table 2 are presented the correlations between demographic and disease related characteristics and C-FSM, HNC-SM, as well as QOL, and self-reported functional prosthetic outcome. The effect of CFM and HNCM on QOL and prosthesis functioning is presented in Table 3. QOL was significantly related to physical ( $r=.41, P=.006$ ), role ( $r=.61, P<.001$ ), emotional ( $r=.49, P=.001$ ), and social ( $r=.47, P=.001$ ) functioning, fatigue ( $r=-.40, P=.007$ ), and pain ( $r=-.48, P=.001$ ). Physical ( $r=-.40, P=.007$ ), role ( $r=-.50, P=.001$ ), and social ( $r=-.60, P<.001$ ) functioning, fatigue ( $r=.53, P<.001$ ), pain ( $r=.56, P<.001$ ), and appetite loss ( $r=.57, P<.001$ ) were significantly correlated to obturator functioning total score. The obturator functioning speech score was strongly affected by role ( $r=-.46, P=.002$ ), emotional ( $r=-.41, P=.006$ ), and social ( $r=-.54, P<.001$ ) functioning, fatigue ( $r=.41, P=.006$ ), pain ( $r=.46, P=.002$ ), appetite loss ( $r=.58, P<.001$ ), financial impact ( $r=.36, P=.003$ ), and mouth dryness ( $r=.31, P=.005$ ). Social functioning ( $r=-.44, P=.003$ ) and pain ( $r=.46, P=.003$ ) were also strongly related to the obturator functioning eating score. The obturator functioning appearance score was strongly associated with role functioning ( $r=-.55, P<.001$ ), fatigue ( $r=-.55, P<.001$ ), pain ( $r=.49, P=.001$ ), appetite loss ( $r=.65, P<.001$ ), and financial impact ( $r=.30, P=.003$ ). Role ( $r=-.40, P=.008$ ), emotional functioning ( $r=-.44, P=.003$ ), fatigue ( $r=.40, P=.007$ ), pain ( $r=.49, P=.001$ ), appetite loss ( $r=.48, P=.001$ ), financial impact ( $r=.41, P<.001$ ), and the perception of feeling ill ( $r=.36, P=.003$ ) were strongly related to the obturator functioning insertion score.

In Table 4 are presented the prosthesis functioning challenges that were significantly associated with improved quality of life. More challenges with the complete denture obturator prosthesis lead to poor quality of life ( $r=-.58, P<.001$ ). Modules significantly associated with impaired quality of life were avoidance of family/social events ( $r=-.55, P<.001$ ), difficulty in talking in public ( $r=-.53, P<.001$ ), "funny" appearance of the upper lip ( $r=-.53, P<.001$ ), difficulty in being understood ( $r=-.50, P=.001$ ), difference in voice ( $r=-.47, P=.001$ ), upper lip numbness ( $r=-.46, P=.002$ ), trouble in hearing ( $r=-.39, P=.001$ ), difficulty in inserting the obturator ( $r=-.37, P=.001$ ), and nasal leaking on swallowing food ( $r=-.45, P=.002$ ). Regression models are presented in Table 5. Participants' sex ( $P<.001$ ), employment status ( $P=.01$ ), additional treatments ( $P=.016$ ), surgical approach ( $P=.017$ ), size of the horizontal palatal aspect of the maxillectomy defect ( $P=.028$ ), previous prosthetic maxillary experience ( $P=.047$ ), and dental status in the mandible ( $P=.038$ ) were the strongest variables affiliated to ideal functioning of the complete denture obturator functioning. Obturator functioning scale total score ( $P=.001$ ), participants' gender ( $P=.002$ ), ASA status ( $P=.027$ ), and surgical approach ( $P=.039$ ) were the strongest covariates for improved quality of life.

## Discussion

In the present survey the null hypotheses was rejected. QOL and perceived effectiveness of the prosthesis in the older edentulous maxillectomy participants were affected by demographic and disease related characteristics, as well as C-FSM, and HNC-SM, whereas the perceived function of the complete denture obturator prosthesis significantly influenced QOL following surgical intervention. A self-reported functional and efficient complete denture obturator prosthesis appeared to be the strongest predictor for advanced QOL in the older edentulous participants. This outcome was compatible with earlier reports conducted in the general population [10-13]. Attributes of the complete denture obturator functioning specifically important for enhanced quality of life were restoration of participants' speech, swallowing, and appearance, parameters that significantly complicated the patients' daily life and routine. Most older patients stated that they were often distressed due to their difficulties in talking in public and being understood, as well as due to the

difference in their voice and their hearing impairment, items that significantly interfered with their ability to participate in a public conversation. Furthermore, esthetic issues such as the appearance and altered sensation of their upper lip, mainly associated with the extraoral Weber-Ferguson surgical approach, concerned the older participants and created anxiety that complicated their social relationships. Many older patients stated that the challenges they had to deal with when placing the prosthesis, hampered their role, emotional, and cognitive functioning, created pain, fatigue, and “made them feel ill”, since the sustained attempts to insert the obturator correctly represented a persistent reminder of their disease. In addition, older women participants presented with significant lower physical and cognitive functioning and QOL scores, reported more problems with swallowing and social contact, as well as insertion difficulties of the prosthesis, alike earlier studies in the general population [12,22]. Pain and fatigue were significantly higher in the older female participants’ group, items that were both significant determinants for poor QOL, findings also similar to the aforementioned research studies [12,22].

Consistent to previous studies considering the general population [10,11], the extend of the primary tumor affected the perceived effectiveness of the complete denture obturator prosthesis in the older participants, as well as their speech intelligibility and eating capability. Generally, the principal factors associated with effective prosthetic rehabilitation are adequate stability, support, and retention of the obturator prosthesis, parameters particularly important in edentulous patients, since the retention of the complete denture obturator prosthesis greatly depends on the size and the location of the tumor, the size and the extend of the resultant defect, the remaining portion of the premaxilla, and the available tissue undercuts [23-25]. In the present study, the extend of the horizontal palatal component of the consequent defect was significantly related to the self reported function of the prosthesis. Participants with a resultant Brown a horizontal component reported better overall functioning of the prosthesis, improved speech and less emotional functioning issues, when compared with participants with a more extensive and prosthetically challenging Brown b or c palatal component. The lack of a significant effect of the defect size on the overall QOL was also consistent with previously mentioned studies [10,11], since many participants could have accepted their limitations and adjusted to their prosthesis over the one year interval between the delivery of the prosthesis and the interview. Furthermore, the fact that they survived such a severe life threatening disease could have outweighed their residual long term disability that in addition to the expertise of the treating maxillofacial prosthodontist could have created a positive attitude while maintaining a normal routine with their prosthetic rehabilitation .

Additional factors that significantly affected the perceived functioning of the complete denture obturator were the prosthetic history of the participants, and the status of the opposing mandibular dentition findings similar to previous reports conducted in the general population [12,26]. Usually, when it comes to complete denture treatment the prosthetic history is directly associated with the success of the rehabilitation; therefore in the present study, for participants with a prior removable denture experience the transition to the complete denture obturator prosthesis was smoother with more predictable functional and esthetic outcomes. In addition, the edentulous state of the mandible in some participants further complicated the prosthetic outcome, since the fabrication of a complete denture obturator prosthesis with an opposing a mandibular complete denture usually represents a unique challenge for the maxillofacial prosthodontist [25].

Similar to the data of earlier studies in the general population [21,27], the participants who received a Weber-Ferguson facial surgical approach, were more severely affected by their treatment, since they had poor QOL scores and more problems when using the complete denture obturator prosthesis. From a prosthodontic standpoint, the intraoral surgical approach when possible could enhance the prosthodontic rehabilitative outcome in patients with complete denture obturator prostheses [25]. On the other hand, the Weber-Ferguson facial surgical approach with the consequent facial scar and the contraction of the cheek is a more radical intervention that usually creates an extensive surgical defect that is more difficult to prosthetically obturate. Moreover, when operated extraorally and regardless their older age most participants reported significant challenges with their appearance, since the life preserving surgical intervention can be life changing creating visually confronting facial disfigurement and physical deformity, reduced self-esteem and disturbed

body image [28]. Consequently, recovery may be prolonged generating social anxiety and emotional distress resulting to psychosocial deficits, limited ability to engage in social relationships, isolation, elevated psychological disruption, and impaired QOL [28].

The adjuvant treatment modalities, similarly to previous reports carried out in the general population [10-13], were strong predictors of perceived obturator functioning, since the post-radiation trismus and the associated lymphedema, may significantly impair the stability and retention of the complete denture obturator prosthesis. However, unlike the same reports [10-13] administered adjuvant treatment did not alter the participants' QOL, but affected their physical functioning, which was generally low even in those who underwent only surgical resection, probably due to their older age. In the present study, elderly participants did not report significant post radiation and/or post chemotherapy side effects. This finding along with their already impaired physical status, could probably explain their unaffected overall QOL. Most likely in most participants xerostomia was already established mainly due to their age and their additional medications for chronic diseases, therefore radiation induced xerostomia was not significantly addressed. Furthermore, most participants were edentulous in both jaws and were wearing complete dentures, therefore the presence of highly polished, smooth, less abrasive, and easily cleaned acrylic surfaces that did not harbor fungus and bacteria, significantly reduced the incidence of radiation and/or chemotherapy induced oral mucositis, fungal infections, and the associated pain.

Compatible with earlier studies [3,4], participants' comorbidities as interpreted by the ASA physical status, significantly affected postoperative QOL, since participants with severe systemic disease and ASA III index, reported worse physical functioning and defective QOL. They did however report better eating capability with the complete denture obturator prosthesis, since most likely most participants with ASA III performance status were older with no significant social life and were already complete denture wearers, conditions that both contributed to a more unchallenging transition to the use of complete denture obturator prosthesis. Nevertheless, it is important to evaluate the relation between the extend of the disease, comorbid conditions, performance status, functional consequences, survival probability, and overall QOL, since patients with ASA III physical status, diagnosed with extensive tumors and poor anticipated postoperative survival may not benefit from radical ablative surgical resections.

The constrains of this study involve the exclusion of participants with implant-retained complete denture obturator prostheses, the absence of objective measurements, and the insufficient evaluation of the psychological state of the older participants due to cancer related anxiety and distress. Future prospective multicentered combining self-reported outcomes with clinical objective measurements to evaluate the prosthesis functioning should be planned.

## Conclusions

Quality of life and maxillofacial prosthetic rehabilitation are closely interacting concepts when it comes to head and neck cancer experience. Older participants who stated that their complete denture obturator prosthesis was functionally and esthetically effective, reported also improved quality of life. The perceived effectiveness of the complete denture obturator prosthesis was depended on the surgical approach, the size of the resultant defect, the prosthetic history of the elderly participants, and the mandibular dentition. The older participants with severe systemic diseases had worse QOL scores, but reported better eating capability with the complete denture obturator prosthesis when compared to their peers with mild systemic diseases.

## Declarations

**Conflict of Interest:** The authors declare that they do not have any conflict of interest.

**Ethics approval:** The study protocol was approved by the ethics committee of NKUA

(2015-268), in compliance with the Helsinki declaration and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines.

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**Consent to participate:** All the participants signed an informed consent before enrolling in the present study.

**Consent for publication:** All the participants consent for the publication of any identifiable details, which can include photograph(s) and/or videos, data, case history and/or details in the present manuscript.

**Availability of data and material:** The data is available in the hospital's medical charts. The measurement instruments were described in the materials and methods section of the manuscript.

**Authors' contributions:**

**Dr. Artopoulos:** Conception and design of the study, analysis of data, interpretation of data, drafting of manuscript, and final approval of the version to be submitted.

**Dr. Sarafianou:** Acquisition of data.

**Dr. Perisanidis:** Critical revision.

**Dr. Polyzois:** Critical revision.

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## Tables

**Table 1. Profile of the 44 participants.**

<b>Levels</b>	<b>Frequency</b>	<b>Percentage (%)</b>
<b>Gender</b>		
Male	17	38.6
Female	27	61.4
<b>Age</b>		
65-80	27	61.4
80+	17	38.6
<b>Marital status</b>		
Married	24	54.5
Single, Divorced or Widowed	20	45.5
<b>Employment status</b>		
Employed	8	18.2
Unemployed	13	29.5
Retired	23	52.3
<b>Smoking before treatment</b>		
Yes	25	56.8
No	19	43.2
<b>Smoking after treatment</b>		
Yes	3	6.8
No	41	93.2
<b>Alcohol before treatment</b>		
Yes	10	22.8
No	15	34
Socially	19	43.2
<b>Alcohol after treatment</b>		
Yes	3	6.8
No	16	36.4
Socially	25	56.8
<b>American Society of Anesthesiologists (ASA) Classification</b>		
II	23	52.3
III	21	47.7

<i>Tumor size (T)</i>		
<i>T1</i>	8	18.2
<i>T2</i>	15	34.1
<i>T3</i>	13	29.5
<i>T4</i>	8	18.2

<b>Regional lymph nodes (N)</b>		
N0	29	65.9
N1	5	11.4
N2a	5	11.4
N2b	2	4.5
N2c	3	6.8
<b>Dental status prior to maxillectomy (maxilla)</b>		
Edentulous	16	36.4
Partially edentulous	20	45.5
Dentate	8	18.2
<b>Dental status prior to maxillectomy (mandible)</b>		
Dentate	9	20.4
Partially edentulous	18	40.1
Edentulous	7	39.5
<b>Removable prosthetic experience prior to maxillectomy (maxilla)</b>		
None	8	18.2
Removable partial denture (RPD)	20	45.5
Complete denture (CD)	16	36.4
<b>Brown Classification of the horizontal component of the maxillectomy defect</b>		
a	32	72.8
b	9	20.4
c	3	6.8
<b>Adjuvant therapy</b>		
None	18	40.9
Radiation therapy (XRT)	15	34.1
Radiation + chemotherapy (XRT+chemo)	11	25
<b>Surgical approach</b>		
Intraoral	20	45.5
Extraoral (Weber-Ferguson)	24	54.5

Table 2. Correlations between demographic and disease related characteristics and C-FSM and HNC-SM, as well as QOL, and self-reported functional prosthetic outcome.

<i>Scales</i>	<i>Participants (Median (SD, min-max))</i>				<i>P</i>
	<b>Gender</b>				
	<b>Male</b>		<b>Female</b>		
Quality of Life	66.7 (18.4, 33.33-100)		50 (19.75, 16.67-100)		.009
Physical functioning	100 (10.60, 66.67-100)		86.67(16.96, 33.33-100)		.015
Cognitive functioning	100 (13.10, 50-100)		83.33 (20.72, 16.67-100)		.011
Fatigue	11.11 (16.45, 0-55.56)		33.33 (22.07, 0-88.89)		.006
Pain	0 95.54, (0-16.67)		16.67 (19.40, 0-50)		.002
OFS Insertion	1 (.47, 1.0-2.0)		2 (.93, 1.00-4.00)		.015
Problems with swallowing	0 (21.61, 0-91.67)		16.67 (21.46, 0-75)		.040
Problems with social contact	0 (23.38, 0-86.67)		26.67 (23.36, 0-86.67)		.009
	<b>Age</b>				
	<b>65-80</b>		<b>80+</b>		
Physical functioning	93.33 (11.13, 60-100)		80 (18.89, 33.33-100)		.012
	<b>American Society of Anesthesiologists (ASA) Classification</b>				
	<b>II</b>		<b>III</b>		
Physical functioning	93.33 (14.47, 46.67-100)		83.34 (15.94, 33.33-100)		.003
OFS Eating	2 (.93, 1.00-4.33)		1.33 (.44, 1.00-2.33)		.025
	<b>Tumor size (T)</b>				
	<b>T1</b>	<b>T2</b>	<b>T3</b>	<b>T4</b>	
OFS Total	1.29 (.73, 1.20-3.18)	1.35 (.22, 1.00-1.76)	1.76 (.82, 1.00-3.47)	1.91 (.82, 1.18-3.94)	.016
OFS Speech	1.2 (.28, 1.00-2.00)	1.4 (.69, 1.00-3.00)	2 (1.19, 1.00-4.40)	2 (.66, 1.20-3.40)	.003
OFS Eating	1.00 (.35, 1.00-2.00)	1.33 (.82, 1.00-3.33)	1.67 (.88, 1.00-3.67)	2.00 (.84, 1.67-4.33)	.002
	<b>Brown Classification of the horizontal component of the maxillectomy defect</b>				
	<b>a</b>	<b>b</b>	<b>c</b>		
OFS Speech	1.2 (.12, 1.00-1.80)	1.7 (.86, 1.00-3.80)	2.2 (1.12, 1.60-4.40)		.012
Emotional functioning	83.33 (12.73, 75-100)	75 (20.77, 25-100)	62.50 (30.2, 0-91.67)		.014

<i>Adjuvant therapy</i>				
	<i>None</i>	<i>Radiation therapy (XRT)</i>	<i>Radiation + chemotherapy (XRT+chemo)</i>	
Physical functioning	83.34 (4.71, 80-86.67)	80 (11.29, 66.67-100)	75 (14.52, 46.67-100)	.011
Nausea	0 (8.81, 0-33.33)	16.67 (29, 0-66.67)	50 (23.57, 33.33-100)	.008
Appetite loss	33.33 (20.21, 0-66.67)	33.33 (27.80, 0-100)	66.67 (0, 66.67-100)	.018
<i>Surgical approach</i>				
	<i>Intraoral</i>	<i>Extraoral (Weber-Ferguson)</i>		
OFS Appearance	1.25 (.61, 1.00-3.25)	1.75 (.74, 1.00-4.25)		.023
Social functioning	83.33 (26.65, 16.67-100)	66.67 (24.90, 16.67-100)		.025

**Table 3. The effect of C-FSM and HNC-SM on QOL and OFS.**

<sup>a</sup> Correlation significant ( $P<.01$ ). <sup>b</sup> Correlation significant ( $P<.05$ ). <sup>c</sup> Higher rho values indicate better quality of life and better complete denture obturator functioning scores. <sup>d</sup> Higher rho values indicate worse quality of life and worse complete denture obturator functioning scores.

**Table 4. Correlations of complete denture obturator functioning modules with prosthesis functioning total score and quality of life.**

	Global Quality of Life (QOL) (rho)	OFS scores				
C-FSM		Total (rho)	Speech (rho)	Eating (rho)	Appearance (rho)	Insertion (rho)
<i>Physical functioning<sup>c</sup></i>	0.41 <sup>a</sup>	-0.40 <sup>a</sup>	-0.35 <sup>b</sup>	-0.28	-0.34 <sup>b</sup>	-0.25
<i>Role functioning<sup>c</sup></i>	0.61 <sup>a</sup>	-0.50 <sup>a</sup>	-0.46 <sup>a</sup>	-0.26	-0.55 <sup>a</sup>	-0.40 <sup>a</sup>
<i>Emotional functioning<sup>c</sup></i>	0.49 <sup>a</sup>	-0.29	-0.41 <sup>a</sup>	-0.12	-0.32 <sup>b</sup>	-0.44 <sup>a</sup>
<i>Cognitive functioning<sup>c</sup></i>	0.37 <sup>b</sup>	-0.34	-0.30 <sup>b</sup>	-0.27	-0.25	-0.32 <sup>b</sup>
<i>Social functioning<sup>c</sup></i>	0.47 <sup>a</sup>	-0.60 <sup>a</sup>	-0.54 <sup>a</sup>	-0.44 <sup>a</sup>	-0.55 <sup>a</sup>	-0.35 <sup>b</sup>
<b>Symptoms<sup>d</sup></b>						
Fatigue	-0.40 <sup>a</sup>	0.53 <sup>a</sup>	0.41 <sup>a</sup>	0.35 <sup>b</sup>	0.43 <sup>a</sup>	0.40 <sup>a</sup>
Nausea and Vomiting	-0.20	0.37 <sup>b</sup>	0.32 <sup>b</sup>	0.35 <sup>b</sup>	0.26	0.18
Pain	-0.48 <sup>a</sup>	0.56 <sup>a</sup>	0.46 <sup>a</sup>	0.46 <sup>a</sup>	0.49 <sup>a</sup>	0.49 <sup>a</sup>
Dyspnoea	-0.17	0.38 <sup>b</sup>	0.31 <sup>b</sup>	0.49 <sup>a</sup>	0.16	0.06
Insomnia	-0.20	0.43 <sup>a</sup>	0.54 <sup>a</sup>	0.41 <sup>b</sup>	0.30	0.55 <sup>a</sup>
Appetite loss	-0.34 <sup>b</sup>	0.57 <sup>a</sup>	0.58 <sup>a</sup>	0.34 <sup>b</sup>	0.65 <sup>a</sup>	0.48 <sup>a</sup>
Constipation	-0.21	0.34 <sup>b</sup>	0.33 <sup>b</sup>	0.44 <sup>a</sup>	0.16	0.25
Diarrhea	-0.19	0.30 <sup>b</sup>	0.19	0.24	0.33 <sup>b</sup>	0.22
Financial impact	-0.15	0.23	0.36 <sup>b</sup>	0.04	0.30 <sup>b</sup>	0.41 <sup>a</sup>
<b>HNC-SM<sup>d</sup></b>						
Pain (Head and Neck)	-0.15	0.23	0.23	0.23	0.08	0.27
Swallowing problems	-0.08	0.09	0.11	0.11	0.03	0.11
Senses problems	-0.01	0.21	0.19	0.26	0.06	0.18
Speech problems	-0.16	0.03	0.03	0.06	0.03	0
Social Eating problems	-0.15	0.09	0.09	0.06	0.09	0.10
Social Contact problems	-0.15	0.09	0.09	0.08	0.09	0
Sexual problems	-0.23	0.03	0.03	0.11	0.29	0.20 <sup>b</sup>
Teeth problems	-0.04	0.04	0.04	0.12	0.04	0.15
Mouth Opening problems	-0.08	0.12	0.07	0.13	0.08	0.14
Dry Mouth	-0.24	0.24	0.31 <sup>b</sup>	0.30	0.06	0.28

Sticky Saliva	-0.09	0.14	0.22	0.26	0.10	0.21
Coughing	-0.84	0.13	0.17	0.15	0.09	0.13
Felt Ill	-0.32	0.19	0.22	0.16	0.25	0.16

Item	OFS Total score (rho) <sup>c</sup>	Quality of Life score (rho) <sup>d</sup>
<b>OFS Total</b>	-	-0.58 <sup>a</sup>
<b>OFS Speech score</b>	0.85 <sup>a</sup>	-0.44 <sup>a</sup>
Speech is nasal	0.70 <sup>a</sup>	-0.27
Difficulty in being understood	0.81 <sup>a</sup>	-0.50 <sup>a</sup>
Difficulty in talking in public	0.79 <sup>a</sup>	-0.53 <sup>a</sup>
Difficulty in pronouncing words	0.72 <sup>a</sup>	-0.38 <sup>b</sup>
Difference in voice	0.69 <sup>b</sup>	-0.47 <sup>a</sup>
<b>OFS Eating score</b>	0.80 <sup>a</sup>	-0.36 <sup>b</sup>
Nasal leaking on swallowing liquids	0.66 <sup>a</sup>	-0.17
Nasal leaking on swallowing food	0.57 <sup>a</sup>	-0.46 <sup>a</sup>
Difficulty in chewing food	0.76 <sup>a</sup>	-0.32 <sup>b</sup>
<b>OFS Appearance score</b>	0.84 <sup>a</sup>	-0.53 <sup>a</sup>
Avoided family and social events	0.58 <sup>a</sup>	-0.55 <sup>a</sup>
Dissatisfied with looks	0.74 <sup>a</sup>	-0.35 <sup>b</sup>
Upper lip is numb	0.73 <sup>a</sup>	-0.46 <sup>a</sup>
Noticeable clasps	0.13	-0.48
Upper lip looks funny	0.70 <sup>a</sup>	-0.53 <sup>a</sup>
<b>OFS Insertion score</b>		
Difficulty in inserting the obturator	0.58 <sup>a</sup>	-0.37 <sup>b</sup>
<b>Other</b>		
Difficulty in inbreathing while eating	0.58 <sup>b</sup>	-0.16
Dryness of mouth	0.64 <sup>a</sup>	-0.30 <sup>b</sup>

<sup>a</sup> Correlation significant ( $P < .01$ ). <sup>b</sup> Correlation significant ( $P < .05$ ). <sup>c</sup> Higher rho values indicate worse complete denture obturator functioning scores. <sup>d</sup> Higher rho values indicate worse quality of life scores.

**Table 5. Hierarchical multivariable rank regression.**

Variable	OFS Total score						Quality of Life score					
	Model 1			Model 2			Model 1			Model 2		
	B	SE	$\beta$	B	SE	$\beta$	B	SE	$\beta$	B	SE	$\beta$
<i>Age (80+)</i>	-	-	-	-	-	-	-	-	-	-	-	-
<i>Sex (Female)</i>	.524	.167	.443*	.372	.171	.314*	-.573	.187	-.491*	-.385	.169	-.330*
<i>American Society of Anesthesiologists (ASA) Classification (III)</i>	-	-	-	-	-	-	-22.85	9.84	-.544*	-19.97	9.58	-.475*
<i>Additional treatment modalities (XRT), (XRT+chemo)</i>	.372	.249	.236**	.600	.256	.381**	-	-	-	-	-	-
<i>Surgical approach (Extraoral/Weber-Ferguson)</i>	.042	.218	.036**	.086	.215	.074**	-.380	.177	-.333*	-.218	.158	-.191*
<i>Dental status of the mandible (Dentate)</i>	-	-	-	.323	.432	-.279**	-	-	-	-	-	-
<i>Removable prosthetic experience prior to maxillectomy (maxilla) (None)</i>	-	-	-	.372	.337	.298**	-	-	-	-	-	-
<i>Brown Classification of the horizontal component of the maxillectomy defect</i>												
<i>a</i>	-	-	-	-.199	.345	-.091**	-	-	-	-	-	-
<i>b</i>	-	-	-	-.324	.278	-.234**	-	-	-	-	-	-
<i>c</i>	-	-	-	.296	.216	.288**	-	-	-	-	-	-
<i>OFS Total</i>	-			-			-	-	-	-.514	.141	-.522*
<i>R<sup>2</sup></i>	.470			.574			.308			.503		
<i>F</i>	3.35*			3.11*			1.95**			3.82*		

\* Correlation significant ( $P < .01$ ). \*\* Correlation significant ( $P < .05$ ). Positive beta weights indicate positive relationship between predictor and prosthesis functioning and quality of life variance; negative beta weights indicate negative relationship.