Functional inoperability of oral and oropharyngeal cancer
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Citation for published version (APA):

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Chapter 6

Oral function after maxillectomy and reconstruction with an obturator.

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ABSTRACT

Maxillectomy defects can be reconstructed by a prosthetic obturator or (free) flap transfer, but there is no consensus about the optimal method.

This study evaluated 32 maxillectomy patients with prosthetic obturation regarding function (mastication, subjective oral and swallowing complaints and maximal mouth opening). Outcomes were related to extent of the resection (Brown Maxillectomy classification\(^1\)), dentition and history of adjuvant radiotherapy.

Maxillectomy defects ranged from 2-1 to 4B on the Brown classification, and most had a defect graded as 2-A or 2-B. Mean mixing ability test after 10 chewing strokes was 24.2 and after 20 chewing strokes 19.7, which compares to edentulous healthy individuals. None of the outcomes was influenced by Brown classification. Radiotherapy negatively influenced mean maximal mouth opening (29.1 mm versus 40.9 mm, p=0.017) and subjective outcomes. Edentate obturated patients had worse outcomes than dentate patients, measured by mixing ability test and questionnaire.

In conclusion, mastication after obturator reconstruction of a maxillectomy defect is comparable to mastication with full dentures. Size of the maxillectomy defect did not significantly influence functional outcome, but adjuvant radiotherapy resulted in worse mouth opening and self-reported oral and swallowing problems. Residual dentition had a positive influence on mastication and subjective outcomes.
INTRODUCTION

The incidence of patients undergoing a maxillectomy for maxillary cancer or oral cancer invading the hard palate is low. The annual incidence rate of maxillary sinus carcinoma is less than 1/100,000 inhabitants in the USA. In the Netherlands, in 2007 the incidence of oral cavity carcinoma was 5.4 per 100,000 inhabitants. Only 9% of all oral cavity carcinomas are localised in the hard palate and 12% at the gingiva.

Several epithelial subtypes of malignancies are found at the maxillary sinus; squamous cell carcinoma, adenocarcinoma, adenoid cystic carcinoma, salivary gland carcinoma, or malignant melanoma. Treatment consists mainly of surgery and/or radiotherapy. The complex anatomy and proximity of many critical structures, such as the eye, brain and cranial nerves, makes treatment challenging. In case of squamous cell carcinoma concurrent chemoradiation with or without debulking can be considered for unresectable tumours or if resection leads to an unacceptable functional result, currently known as functional inoperability.

Informing patients preoperatively about the expected functional result is of utmost importance. A maxillectomy may induce severe functional problems due to disabling alterations in the functional components of occlusion, potentially leading to severely impaired mastication causing dietary changes. Other postoperative problems may be hypernasal speech or nasal leakage.

To test the chewing function a wax compound method was chosen rather than a fragmentation method because of a difficulty collecting of fragmented particles (i.e. particles disappear into the defect) and the higher risk of aspiration. Wax compound stays in one piece and does not have these disadvantages although it is sticky at first and becomes softer with rising temperature in the oral cavity during chewing. These disadvantages can be overcome by wrapping the tablets with saliva before the first chewing stroke. Before offering, the wax can be pre-heated to mouth temperature.

Traditionally, restoration of hard-palate defects has been accomplished with palatal prostheses. This is a simple, non-surgical method to eliminate oronasal and oroantral communication, re-establishing normal speech and maxillary dentition. Other reconstruction options are non-vascularised grafts, local flaps, regional flaps and free revascularised tissue transfer. There is limited literature available about function and quality of life issues in patients using an obturator prosthesis for primary reconstruction of a maxillectomy defect. The optimal reconstruction of the maxillectomy defect remains controversial.
Chapter 6

The aim of this study is to evaluate function after a maxillectomy and prosthetic rehabilitation, in order to carefully select patients for different treatment options, and to provide sufficient preoperative patient counselling.

MATERIALS AND METHODS

The analysis was set up as a retrospective cohort study. The patient sample consisted of patients who underwent a maxillectomy as tumour ablative surgery between 1973 and 2009 and were still under recall of the special dental care unit of the Netherlands Cancer Institute/ Antoni van Leeuwenhoek Hospital and/or the Center for Special Dental Care in Amsterdam. Selection criteria for searching the database were: ‘obturator prosthesis’ or ‘resection prosthesis’ or ‘maxillo-facial defect’. Medical charts were reviewed for inclusion criteria: patients with a definite obturator (approximately 1 year after surgery), location of the defect and the presence of an obturator prosthesis in the maxilla. All patients with a defect of the maxilla and obturator reconstruction were contacted by telephone. If they considered participating in the study, patient information was sent. Patients were excluded if they had a local recurrence, no prosthetic reconstruction, serious psychiatric or cognitive problems or if an extra visit to the hospital would be difficult due to physical condition or distance (more than 45 minutes travelling).

Procedure

After the maxillectomy, a temporary obturato was fabricated peroperatively using gutta percha based on preoperative assessments and dental casts. This obturato was inserted immediately after tumour resection and remained in situ for the following 4-6 weeks, to prevent shrinkage of the maxillectomy cavity. In patients with large defects, the cavity was lined with a split skin graft. Two to three months post surgery an interim obturato was fabricated and after approximately 1 year the patient was provided with the definite obturato, made of acrylic resin based on Beumer’s method,14 see figure 2 of chapter 1. This obturato protocol remained unchanged for the whole study period. Adjuvant radiotherapy was indicated by incomplete resection, bone invasion and multiple lymph node metastases or extracapsular growth. Patients with impaired mouth opening were offered physiotherapy and in the recent years also the TheraBite Jaw Motion Rehabilitation System, a portable medical device used to stretch and strengthen swallowing and jaw muscles, specifically designed to treat trismus and mandibular hypomobility.15 The maxillectomy defects were graded according to Brown maxillectomy classification,1 see figure 1. The oral cavity was inspected for remaining dentition.
Function after a maxillectomy

Figure 1: Brown Classification of Maxillectomy

Surgical defect classified according to vertical dimension of the maxillectomy, class 1-4. Class 1: no oro-nasal or oro-antral fistula or only resection of palatal bone leaving dental-bearing part of maxilla intact. Class 2: not including orbital floor or rim. Class 3: including orbital floor with or without skull base. Class 4: orbital exenteration. Class 2-4 is qualified by addition of a letter (a-c) which refers to the horizontal aspect, a. Less than or equal to the midline of the hard palate, b. Bilateral alveolar maxilla and hard palate, c. Entire alveolar maxilla and hard palate.

Mixing Ability Test

Mastication was evaluated using the mixing ability test (MAT). The test measures how well a subject mixes a tablet, which consists of a red and a blue wax layer. Two tablets were analysed per patient, after 10 chewing strokes (MAT 10x) and after 20 chewing strokes (MAT 20x). The chewed wax is flattened and photographed from both sides. The spread of the colour intensities is the measure of mixing. If the wax tablet has not been chewed, one side is red and the other is blue, and the spread of the intensities of both colours is maximal. Chewing the tablet mixes the colours, intermediate intensities appear, and the spread of the intensities decreases. A lower score means better colour mixing, and correlates with better chewing.

Maximal Mouth Opening

The Maximal Interincisor Opening (MIO) of the mouth was measured by the clinician using the TheraBite range-of-motion scale (Atos Medical, Höry, Sweden). Mouth opening was measured without dentures (total or partial, depending on the patient). Dijkstra et al. did not find a clear cut-off point for the subgroups dentate, partially dentate and edentulous, but mouth opening of 35 mm or less was regarded as the cut-off point for trismus of the total group. Therefore, in this study a cut-off point of 35 mm or less was taken as the threshold for the total group.
Quality of life questionnaire
Patients completed two questionnaires. The first is a Dutch questionnaire based on the questions of the EORTC- H&N 35 questionnaire, see appendix B. This questionnaire includes detailed and symptom-specific questions relevant for this cancer group. It is used frequently in the authors’ institute, showing its validity\textsuperscript{17-19} and without any differences when compared to validated standardised questionnaires such as (EORTC- H&N 35, QLQ-C30 and QLQ-H&N35). Correlation of the 10 questions in the questionnaire regarding oral symptoms (questions 3-13; see appendix B) and eight questions regarding swallowing and eating (questions no. 5 and 7-13; see appendix B) was checked by reliability analysis on SPSS, using Cronbach’s alpha test for assessing internal consistency. For scales used as research tools to compare groups, alpha values of 0.7-0.8 are regarded as satisfactory; for clinical use values of 0.9 are recommended.\textsuperscript{20} Total oral scores could theoretically range from 12 (absolutely no oral complaints), to 48 (very severe oral complaints). Total swallowing score could theoretically range from 8 (no swallowing complaints) to 33 (severe swallowing problems).

Obturateur Functioning Scale
Patients also completed the Obturator Functioning Scale (OFS), developed and tested at Memorial Sloan Kettering Cancer Center as a means of assessing self-reported functioning of an obturator.\textsuperscript{21,22} The scale consists of 15 questions measuring the patient’s ability to eat and speak with the obturator and their satisfaction with the cosmetic effects. A 5-point Likert scale represents each item on the OFS, with descriptors under each point. The outcomes of the OFS score are analysed by adding up the scores per question. The range of this questionnaire was from 15 (absolutely no problems with the obturator) to 75 (very severe problems with the obturator). Internal consistency of the questions was assessed by Crohnbach’s alpha test. The OFS has been translated to Dutch and back into English by two independent translators for use in the Dutch language in this study.

Statistics
Data were evaluated using Excell for Windows and SPSS 15.0. Primary outcome measurements were maximal mouth opening, mixing ability index after 10 and 20 chewing strokes, results of quality of life questionnaires for swallowing and oral symptoms and obturator functioning scale. Primary outcomes were related (using Mann Whitney \textit{U}-test) to the size of the maxillary defect (Brown classification\textsuperscript{1}), history of adjuvant radiotherapy and presence of residual dentition. The total sample size was divided into two major groups; group 1 consisting of patients with a Brown classification 2A or less and group 2 with Brown classification 2B or more. This grouping is based on the horizontal component, a group with a maxillary defect crossing the palatal midline and a group with a defect less or equal to the midline, see figure 1. The relationship between
subjective and objective outcomes was calculated by Jonckheere-Terpstra test. A relationship was regarded as significant if p-value was lower than or equal to 0.05.

RESULTS

Baseline
Eighty-five patients were found in the database. Five patients had died, five patients did not undergo the exact intended treatment regime consisting of maxillectomy and restoration with an obturator. Of the remaining 75 patients, 32 were included. Twelve could not be contacted, six patients had transport problems, one patient could not read Dutch and 14 did not want to participate. Ten patients wanted to participate, but could not be included because of logistic reasons. The study group consisted of 13 men and 19 women with a mean age of 49 years old. Mean time after maxillectomy was 11 years, for all baseline characteristics, see table 1.

Table 1: Baseline data of a retrospective cohort of maxillectomy patients

<table>
<thead>
<tr>
<th></th>
<th>All (n=32)</th>
<th>Brown ≤ 2-A (n=15)</th>
<th>Brown ≥ 2-B (n=17)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13 men (41%)</td>
<td>6 men (40%)</td>
<td>7 men (41%)</td>
<td></td>
</tr>
<tr>
<td>19 women (59%)</td>
<td>9 women (60%)</td>
<td>10 women (59%)</td>
<td></td>
</tr>
<tr>
<td>Mean Age</td>
<td>49 yrs (SD 17.3yrs)</td>
<td>44 yrs (SD 21.1yrs)</td>
<td>53 yrs (SD 12.1yrs)</td>
</tr>
<tr>
<td>Mean Time after</td>
<td>11yrs</td>
<td>13yrs</td>
<td>9yrs</td>
</tr>
<tr>
<td>Maxillectomy</td>
<td>(SD 10.7yrs)</td>
<td>(SD 11.1yrs)</td>
<td>(SD 10.4yrs)</td>
</tr>
<tr>
<td>Postoperative RT</td>
<td>N= 18 (56%)</td>
<td>N= 6 (40%)</td>
<td>N= 12 (71%)</td>
</tr>
<tr>
<td>Thiersch</td>
<td>N= 22 (79%)</td>
<td>N= 9 (60%)</td>
<td>N= 13 (77%)</td>
</tr>
<tr>
<td>Dentate</td>
<td>N= 26 (81%)</td>
<td>N= 12 (80%)</td>
<td>N= 14 (82%)</td>
</tr>
<tr>
<td>Soft palate resection</td>
<td>N= 11 (45%)</td>
<td>N= 3 (20%)</td>
<td>N= 8 (47%)</td>
</tr>
<tr>
<td>Mean remaining % hard palate</td>
<td>40% (SD 23.5)</td>
<td>54% (SD 16.4)</td>
<td>27% (SD 21.6)</td>
</tr>
<tr>
<td>Premaxilla resected</td>
<td>N= 9 (28%)</td>
<td>N= 1 (6.7%)</td>
<td>N= 8 (47%)</td>
</tr>
</tbody>
</table>

Brown= Brown classification of maxillectomy defect, classification 1, 2a-4c, yrs= years, SD= standard deviation, mo= months, RT= radiotherapy

Maxillectomy defect according to Brown maxillectomy classification
Defects ranged from 2-1 to 4B, and the majority of patients had a defect graded as 2-A or 2-B, see table 2. For analytic purposes, patients were grouped, separated by defect classification 2-A or less (group 1) and classification 2-B or more (group 2).
### Table 2: Brown classification of the maxillectomy defect of 32 patients

<table>
<thead>
<tr>
<th>Group</th>
<th>n=</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2-1</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>2-A</td>
<td>13</td>
<td>41%</td>
</tr>
<tr>
<td>2-B</td>
<td>10</td>
<td>31%</td>
</tr>
<tr>
<td>3-A</td>
<td>2</td>
<td>6%</td>
</tr>
<tr>
<td>3-B</td>
<td>4</td>
<td>13%</td>
</tr>
<tr>
<td>4-B</td>
<td>1</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>32</td>
<td>100%</td>
</tr>
</tbody>
</table>

### Mixing ability test
Mean outcome of the MAT 10x was 24.2 and mean MAT 20x was 19.7, see table 3. Mean MAT 10x was higher for Brown group 2 (≥ 2-B) compared to group 1 (≤2-A), 24.9 versus 23.7. Mean MAT 20x was slightly higher for group 2 compared to group 1, 20.0 versus 19.4. This gives an indication that chewing seems worse for patients with larger defects, although this difference was not statistically significant, p=0.395 and 0.637.

### Maximal mouth opening
Mean maximal interincisor opening (MMI) was 34mm. MMI was better for patients with Brown ≤2-A compared to Brown ≥ 2-B (38mm versus 31mm; p=0.227). Fifty-nine percent of the patients with Brown ≥ 2-B had a trismus, compared to 47% in Brown ≤2-A (p=0.492).

### Quality of life
Consistency between answers of the questionnaire about oral complaints in general and swallowing complaints was calculated and Crohnbach’s alpha was 0.90 for both groups of questions. There was no significant difference between patients with Brown classifications ≤2-A and ≥2-B in severity of swallowing and general oral complaints, see the calculated oral and swallowing score in table 3.

### Obturator Functioning Scale
Reliability between the 15 answers of the OFS was calculated; Crohnbach’s alpha was 0.734. Mean OFS was higher for patients with Brown ≥2-B compared to ≤2-A (29.6 versus 25.7; p=0.819), reflecting more complaints about the obturator in patients with a larger maxillectomy defect, although this difference was not significant.
### Table 3: Outcomes of mastication, mouth opening and quality of life after a maxillectomy, grouped by Brown classification,\(^1\) radiotherapy and dentition

<table>
<thead>
<tr>
<th></th>
<th>Mean MAT 10x</th>
<th>Mean MAT 20x</th>
<th>Mean MMI</th>
<th>Mean OFS</th>
<th>Oral score</th>
<th>Swallowing score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>All</strong> (n=32)</td>
<td>24.2 (SD 3.88)</td>
<td>19.7 (SD 5.07)</td>
<td>34.2 (SD 14.21)</td>
<td>27.8 (SD 6.88)</td>
<td>20.0 (SD 6.52)</td>
<td>12.2 (SD 4.44)</td>
</tr>
<tr>
<td>Brown ≤2-A (n=15)</td>
<td>23.4 (SD 4.23)</td>
<td>19.4 (SD 4.76)</td>
<td>37.9 (SD 15.19)</td>
<td>25.7 (SD 5.83)</td>
<td>20.1 (SD 8.27)</td>
<td>12.67 (SD 5.95)</td>
</tr>
<tr>
<td>Brown ≥ 2-B (n=17)</td>
<td>24.9 (SD 3.51)</td>
<td>20.0 (SD 5.47)</td>
<td>31.0 (SD 12.88)</td>
<td>29.6 (SD 7.36)</td>
<td>19.9 (SD 4.76)</td>
<td>11.7 (SD 2.59)</td>
</tr>
<tr>
<td>p*</td>
<td>.395</td>
<td>.637</td>
<td>.227</td>
<td>.819</td>
<td>.596</td>
<td>.145</td>
</tr>
<tr>
<td><strong>No RT</strong> (n=14)</td>
<td>23.1 (SD 3.78)</td>
<td>17.7 (SD 2.53)</td>
<td>40.9 (SD 11.97)</td>
<td>24.8 (SD 6.12)</td>
<td>16.9 (SD 3.82)</td>
<td>10.5 (SD 2.47)</td>
</tr>
<tr>
<td>RT (n=18)</td>
<td>25.0 (SD 3.85)</td>
<td>21.3 (SD 6.01)</td>
<td>29.1 (SD 13.93)</td>
<td>30.1 (SD 6.69)</td>
<td>22.4 (SD 7.21)</td>
<td>13.4 (SD 5.23)</td>
</tr>
<tr>
<td>p*</td>
<td>.217</td>
<td>.133</td>
<td>.017</td>
<td>.72</td>
<td>.014</td>
<td>.029</td>
</tr>
<tr>
<td><strong>Edentate</strong> (n=6)</td>
<td>27.8 (SD 3.02)</td>
<td>25.1 (SD 5.25)</td>
<td>25.7 (SD 18.04)</td>
<td>28.2 (SD 5.27)</td>
<td>26.5 (SD 9.97)</td>
<td>16.2 (SD 8.01)</td>
</tr>
<tr>
<td><strong>Dentate</strong> (n=26)</td>
<td>23.6 (SD 3.60)</td>
<td>18.4 (SD 4.19)</td>
<td>36.2 (SD 12.79)</td>
<td>27.7 (SD 7.29)</td>
<td>18.5 (SD 4.51)</td>
<td>11.2 (SD 2.63)</td>
</tr>
<tr>
<td>p*</td>
<td>.006</td>
<td>.015</td>
<td>.116</td>
<td>.158</td>
<td>.040</td>
<td>.772</td>
</tr>
</tbody>
</table>

*Calculated using Mann Whitney U test, bold values are considered as statistically significant, meaning \(p \leq 0.05\), MAT= Mixing Ability Test, a test that measures the mixing after mastication,\(^8\) MMI= maximal intercisor opening, measured in millimeter, OFS= Obturator Functioning Scale, range 15-75, a high score represents more problems, Oral score= summary of questions regarding oral problems, range 15-75, a high score represents more problems, Swallowing score= summary of questions regarding swallowing, range 8-33, a high score represents more problems, SD=standard deviation.

**Comparison of all separate Brown classifications**

Comparing MAT 10x, MAT 20x, mouth opening, OFS, oral score and swallowing score for all six different groups of Brown classification (from smaller defects to larger: 2-1, 2A, 2B, 3A, 3B, 4B) using Jonckheere-Terpstra test, the authors could not establish a significant relationship between larger defects and any of the outcomes (\(p = 0.400, 0.680, 0.074, 0.397, 0.344, 0.068\), for the above described outcomes, respectively).
Radiotherapy

Radiotherapy (RT) negatively influenced subjective symptoms after maxillectomy, see table 3. Mean OFS score for patients who underwent RT compared to patients without RT was 30.1 versus 24.8; p= 0.72. The mean oral score of patients with RT compared to those without RT was 22.4 versus 16.9; p=0.014. The mean swallowing score of patients with RT compared to without RT was 13.4 versus 10.5; p=0.029. This indicates that patients had more self-reported symptoms after RT. Mean maximal mouth opening was significantly lower after radiotherapy, 29.1 mm versus 40.9 mm; p=0.017. Chewing, assessed by MAT 10x was comparable, and assessed by MAT 20x even better, for the patients with RT compared to those without, but it was not statistically significant different, p=0.217 and 0.133, respectively.

Dentition

Patients retaining a part of their own dentition had better mastication with significant differences for both MAT 10x and MAT 20x (p=0.006 and 0.015 respectively) compared to edentulous patients. Moreover, dentate patients had lower oral scores, meaning less complaints, on the quality of life questionnaires than the edentate patients; mean oral score was 18.5 for dentate patients and 26.5 for edentate patients (p= 0.040). Dentition did not influence the other outcomes, obturator functioning scale or maximal mouth opening, see table 3.

Soft palate resection

Twenty-one patients did not undergo resection of the soft palate, seven had a partial soft palate resection and four a total soft palate resection. No significant differences in outcomes between these subgroups were found.

Premaxilla

Nine patients underwent resection of the premaxilla during maxillectomy. This did not significantly influence the outcomes of MAT, subjective questionnaires or MMI.

Correlation between subjective complaints and MAT

In order to correlate subjective and objective outcomes, three questions were correlated to MAT 10x and 20x. Patients were asked about problems with mastication, about their diet, if they had problems transporting solid food and if they had to drink during eating. These answers were correlated to MAT 10x and 20x. MAT was significantly correlated to masticatory problems as assessed by the questionnaire in most of these questions (six of eight), see table 4, where p-value is calculated by Jonckheere-Terpstra test.
Table 4: Correlation of masticatory performance after 10 and 20 chewing strokes to answers on questions in quality of life questionnaire in maxillectomy patients

<table>
<thead>
<tr>
<th></th>
<th>Do you have chewing problems?</th>
<th>Do you have problems with transport of solid food?</th>
<th>What is your diet? (consistency)</th>
<th>Do you have to drink during eating?</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAT 10x</td>
<td>.030</td>
<td>.018</td>
<td>.022</td>
<td>.067</td>
</tr>
<tr>
<td>MAT 20x</td>
<td>.070</td>
<td>.031</td>
<td>.012</td>
<td>.007</td>
</tr>
</tbody>
</table>

MAT = Mixing Ability Test, a test that measures the mixing after mastication,\(^9\) 10x = after 10 times chewing, 20x = after 20 times chewing, numbers are p-values calculated by Jonckheere-Terpstra test, representing correlation between question and MAT, bold values are considered as statistically significant, meaning \(p \leq 0.05\).

In the questionnaire, patients were asked three questions about mouth opening: self-experienced mouth opening; complaints during eating due to confined mouth opening; and speech problems due to confined mouth opening. The answers were correlated to the objectively measured MMI by Jonckheere-Terpstra test. Subjective experiences were significantly correlated to objectively measured MMI, all p-values were < 0.001.

**DISCUSSION**

The mixing ability test showed that chewing function after maxillectomy is relatively good in this cohort. Individuals with natural dentition have mean masticatory performance score of 20.4 after 10 chewing strokes and 15.8 after 20 chewing strokes. The values for healthy people wearing full dentures are 24.1 after 10 chewing strokes and 21.2 after 20 chewing strokes.\(^9\) Maxillectomy patients with obturator reconstruction compare favourably with the full dentures group; their values in this study were 24.2 after 10 chewing strokes and 19.7 after 20 chewing strokes. This demonstrates that obturation of a maxillary defect has no severe deteriorating effect on mastication.

These results are comparable with earlier reports. Matsuyama et al.\(^{24}\) found similar masticatory function measured by a sieve method in a group of 20 patients with an obturator compared to healthy individuals. Ono et al.\(^{25}\) reported masticatory performance in 27 edentulous maxillectomy patients with an obturator prosthesis and found that the average masticatory performance with reconstruction was comparable to edentulous healthy individuals, tested by measuring the increase in surface area of comminuted pieces of a gummy jelly.

Evaluation of subjective symptoms, measured with the quality of life questionnaire and OFS, showed no significant differences between smaller and larger maxillectomy defects. RT
induces more self-reported oral and swallowing problems. This is probably due to xerostomia and stiffness. It should be noted that in a retrospective study quality of life outcomes can be unreliable. Furthermore, several factors, besides tumour site, age, comorbidities, and reconstruction method, have an effect on the quality of life after surgery,\textsuperscript{26,27} for example women and young patients report more functional problems in subjective studies\textsuperscript{28}. It remains difficult to link quality of life with function. Even in patients with laryngeal cancer, where comparison can be made between patients with and without laryngeal speech, it is difficult to link function and quality of life.\textsuperscript{29} By using both clinical and patient-rated scores it is possible to gain a better judgement of clinical functional defects. In this study, quality of life outcomes about self-reported mastication and mouth opening were comparable to objectively measured outcomes.

Considering the positive results, it should be considered that the very large defects (Brown 3-C en 4-C) are not included, as it is difficult to construct an adequate obturator if the contralateral maxilla is resected as well. In these cases reconstruction can be done with a free osseocutaneous flap.\textsuperscript{30} Assuming these patients as functionally inoperable,\textsuperscript{7} organ-sparing treatment and chemoradiation with or without debulking, might be considered.\textsuperscript{5,6}

The authors’ institutes have longstanding experience in reconstructing these patients with an obturator, which might have contributed to the positive outcomes. The maxillofacial prothetist was actively involved in the whole multidisciplinary process of diagnosis and clinical decision making, which is important for an appropriate maxillofacial obturator reconstruction. Speech therapists were also present during follow-up, so physiotherapy and rehabilitation exercises were adequately applied. The prosthetic team was always very stable and experienced, providing close monitoring of the patient during a long-term follow-up. This might also be the explanation for the finding that the maxillary defect did not significantly influence mouth opening and masticatory performance in this study, although there was a trend for mastication to be worse for larger defects.

Some\textsuperscript{10} advocate that free flaps provide the surgeon an opportunity to deal with the problems of prosthetic obturation: nasal leakage, cleaning and constant prosthetic refinement. It has to be realised that surgical flap reconstruction is still associated with increased operation time, opportunity for failure and possible donor site morbidity. In contrast, fabrication of an obturator prosthesis shortens the operation time significantly and offers the possibility of immediate and adequate dental rehabilitation. During oncological follow-up the maxillectomy defect can be easily examined after removing the obturator prosthesis, so tumour recurrence, the most common therapy failure, may be detected and treated in a timely manner.\textsuperscript{11} A shortcoming of this study is that not all patients could be included. Of the 75 maxillectomy
patients still alive, 14 did not want to participate. This may cause a selection bias, particularly if patients in a worse condition are more likely to refuse participation. Owing to the retrospective nature and the confined patient group, the authors could not assess the influence of all factors, such as rehabilitation exercises. A study comparing obturation versus reconstructive surgery prospectively would be superior. Although this study represents a relatively small cohort and is retrospective, because of the low incidence of these tumours, it will be very difficult to organise large prospective studies to prove superiority of reconstructive surgery or obturation.

**CONCLUSION**

Mastication after obturator reconstruction of a maxillectomy defect is comparable to mastication in patients with full dentures. The size of the maxillectomy defect did not significantly influence mastication, mouth opening or quality of life. Adjuvant radiotherapy negatively influenced mouth opening and subjective outcomes regarding oral and swallowing functions. Residual dentition positively influenced mastication and subjective outcomes.
REFERENCES


