Transoral Resection for Squamous Cell Carcinoma of the Base of the Tongue

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Objective: To review the oncologic and functional outcomes of patients with squamous cell carcinoma of the base of the tongue who underwent transoral tumor resection and neck dissection with or without postoperative adjuvant therapy.

Design: Retrospective medical record review.

Setting: Tertiary referral center.

Patients: All patients undergoing transoral resection of squamous cell carcinoma on the base of the tongue as part of their primary treatment from January 1, 1996, through January 31, 2005.

Main Outcome Measures: We analyzed overall survival, disease-specific survival, local control, and locoregional control rates using the Kaplan-Meier method. Speech and swallowing function and treatment-related morbidity were also analyzed.

Results: A total of 20 patients underwent transoral resection. Four patients had surgery only, 12 had surgery and radiotherapy, and 4 had surgery and chemoradiotherapy. One patient had stage II disease, 3 had stage III disease, and 16 had stage IVA disease. The Kaplan-Meier overall survival rate was 90.0%, and the disease-specific survival rate was 94.7% at 2 years, with a mean follow-up of 3.7 years. Median hospital stay was 4.7 days. Patients who received a tracheostomy underwent decannulation with a median tracheostomy time of 5.5 days. Seven of 9 patients who received a percutaneous endoscopic gastrostomy tube had it removed. Three patients developed local recurrence, there were no regional recurrences, and 2 patients developed distant metastasis.

Conclusions: Transoral resection of squamous cell carcinoma of the base of the tongue with postoperative adjuvant therapy provided excellent local and regional control and minimized morbidity. Transoral resection is a reasonable treatment option for patients with oropharyngeal squamous cell carcinoma, resulting in very low overall loss of organ function in properly selected patients.

Arch Otolaryngol Head Neck Surg. 2009;135(12):1231-1238

SQUAMOUS CELL CARCINOMA (SCC) of the base of the tongue (BOT) is one of the most common subsites of cancer of the oropharynx, and it is a considerable management problem for patients and physicians. Treatment can be surgical or nonsurgical (or both), and the extent of surgical treatment is determined largely by tumor size. Surgery can range from simple wide local excision to mandibulectomy combined with oropharyngectomy and microvascular reconstruction. Nonsurgical treatment is determined by the stage of disease and functional status of the patient; it can range from primary radiotherapy (RT) to combined chemoradiotherapy with variations in timing and coordination of modalities. No definite consensus exists about the best treatment option. Many authors advocate primary RT for any stage of BOT SCC,1,2 but some suggest that surgical treatment, in combination with adjuvant therapy, is more effective than nonsurgical therapy at controlling even advanced disease.3,8 Other authors have recommended chemoradiotherapy for early- and late-stage disease; this recommendation is based on the idea that oncologic and functional results are similar for the 2 treatments and that the severe complication rate is higher for patients receiving surgical therapy.3,8 An overall trend in treating advanced oropharyngeal cancer with organ preservation protocols has increased, use of RT alone has decreased, and rates of cancer-directed surgery have remained stable since 1985.9

Parsons et al10 reviewed treatment results from 51 retrospective studies and described 6400 patients with tonsillar and BOT cancer who underwent surgery with or without RT or RT with or without neck dissection at North American academic medical institutions. They stated that the expected results for surgery with or without RT and RT with or without neck dis-
section were as follows, respectively: local control, 79% and 76%; locoregional control, 60% and 69%; and 5-year survival, 49% and 52%. These benchmark figures for treatment outcomes also show why most patients with advanced BOT carcinoma have a 5-year survival probability of approximately 50%. Because the rate of severe complications in these studies was 32% for surgery with or without RT and 3.8% for RT with or without neck dissection, the authors (and many other practitioners) concluded that the latter treatment was preferred for all patients with BOT carcinoma, regardless of disease stage. All but 1 of the reports examining surgical complication rates reviewed the treatment of patients from more than 20 years ago. However, surgical treatment of oropharyngeal carcinoma has undergone a revolution of techniques in the past 2 decades. Tumor access previously was gained through mandibulotomy and disruption of the musculature of the mouth floor; at present, access can be achieved transorally with the aid of improved instrumentation and optics. With the advent and development of robotic-assisted surgery, we are gaining even better surgical access to tumors once thought unresectable without major morbidity. Innovations in imaging have improved the recognition of primary tumor boundaries and metastatic disease. Techniques in pathology have improved the speed and accuracy of the histologic assessment of tissue at the time of surgery. Microvascular reconstruction after resection of advanced tumors has greatly improved the rate and extent of the patient’s functional recovery. Conservation surgery has arisen from a desire to decrease the functional impairment of patients as a result of major exirptative surgery, while still achieving control rates similar to those for more radical surgery. It is defined as a surgical procedure that removes all underlying tumor with the same cure as radical surgery but with preservation of structure and function. Often, it is combined with adjuvant RT or chemoradiotherapy.11,12

For 2 decades, we have considered conservation surgery with or without adjuvant therapy as an effective and useful treatment for patients with SCC of the BOT and other oropharyngeal sites. It is an approach similar to that described by others with acceptable outcomes.13 A total of 141 patients underwent surgical resection for primary BOT carcinoma during the study period. In this report, we review the outcomes of the 20 patients with BOT SCC who underwent transoral resection with the use of microscope and laser, as well as neck dissection with or without adjuvant therapy. We did not use robotic assistance in any of these patients. Our outcomes when using the robotic device for this surgery are currently under evaluation and will be presented and subsequently published later. We have previously presented our data concerning survival and functional outcomes for transoral removal of tonsillar SCC.14 These outcomes may also be considered benchmarks for comparing treatment protocols.

RESULTS

We retrospectively reviewed the medical records of patients who underwent treatment of BOT SCC with transoral surgery. Patients were selected for transoral surgery on the basis of the extent of the primary tumor. Contraindications to transoral surgery included trismus, inability to access the primary tumor, and deeply invasive tumors. Patients were excluded from the study if they had recurrent cancer or if they had received any therapy before presentation at our institution. All surgical procedures were performed at the Mayo Clinic; tumor resection procedures included excision of the entire extent of the BOT tumor. Tumors were excised with the intent to achieve negative margins (intraoperatively determined). Adjuvant RT or chemoradiotherapy was administered to patients with pathologically confirmed neck nodal disease (N2 and more severe) or evidence of extracapsular spread of nodal disease, primary site lymphovascular invasion, or stage IV tumors.

Because this review was retrospective, the adjuvant treatment used was heterogeneous and reflects the shifts in treatment recommendations by radiation oncologists and medical oncologists during the study period. For instance, patients requiring postoperative adjuvant therapy received mainly RT alone before 2003, and subsequent patients frequently received recommendations for postoperative chemoradiotherapy on the basis of data showing an improvement in survival, albeit with an increase in morbidity.

Patient information was retrieved from the initial presentation through the date of the last follow-up or death. We abstracted data about the presenting symptoms, clinical and pathological stages, nodal status (size, location, level, extracapsular spread, and angioinvasion), tumor stage, surgical procedure, adjuvant therapy, reconstruction, presence of a temporary tracheostomy or a feeding tube, presence of a percutaneous endoscopic gastrostomy tube, swallowing function, local and locoregional control, development of second primary lesions, and survival.

All patients underwent clinical and pathological staging according to the criteria of the American Joint Committee on Cancer.15 This system subdivides stage IV cancers into stage IVA (T4a, N0 to N2, and M0 [the tumor invades the larynx, the deep/extrinsic muscle of tongue, the medial pterygoid, the hard palate, or the mandible]); stage IVB (T4b, any N stage, M0 [the tumor invades the skull base, the carotid artery, the lateral pterygoid muscle or plate, or the nasopharynx] or any T, N3, M0), and stage IVC (any T stage, any N stage, M1).

Standard descriptive statistics were used to summarize the data. Duration of follow-up was calculated from the date of transoral resection to the date of last follow-up or death. The mean (SD) duration of follow-up was 3.7 (2.7) years (median, 3.2 years). Overall survival, disease-specific survival, and locoregional control were estimated using the Kaplan-Meier method. All analyses were performed using commercially available software (SAS software package; SAS Institute Inc, Cary, North Carolina).

PATIENT CHARACTERISTICS

We identified 20 consecutive patients who underwent transoral BOT resection to treat invasive SCC. Patient characteristics are shown in Table 1. In 4 of the patients (20%), the diagnosis was made at our facility.

METHODS

After obtaining approval from the Mayo Clinic institutional review board, we used the Mayo Clinic tumor registry to identify patients who underwent any surgical resection of an oro-
The remaining patients had received diagnoses elsewhere and were referred to our institution; results of their pathological studies were reviewed before therapy was prescribed.

Clinical and Pathological Staging and Tumor Factors

Before surgery, 13 patients (65%) had stage IVA cancer, and most had advanced-stage clinical neck disease (N2, 13 patients [65%]; N3, 0). The pathological TN stages determined at surgery are listed in Table 2. By surgical confirmation, 3 patients (15%) had stage III disease and 16 (80%) had stage IVA disease. This increase in stage was due to increased detection of metastasis in the surgical neck specimen; these malignant neoplasms were not recognized previously during clinical examination or preoperative imaging. Ipsilateral neck dissections were performed on all patients except 1 with the intent to remove nodal basins at least in zones II through IV.16 Seventeen patients had removal of ipsilateral nodes in at least zones I through IV; 2 patients had zones II through IV dissected. Seventeen patients (85%) had at least 1 positive node, although preoperative evaluation showed 8 (40%) with a T1 and 8 (40%) with a T2 primary tumor. A contralateral neck dissection was performed on 8 patients. Of these 8 patients, 4 had at least 1 positive lymph node.

Surgical specimens were examined histologically. Eight patients had lymph nodes with extracapsular extension, although the median nodal size was 2.7 cm. Conventional keratinizing SCC was the diagnosis for 19 patients (95%). Tumor grade was 2 in 2 patients, 3 in 14 patients, and 4 in 4 patients. Desmoplastic reaction, perineural spread, and angiolymphatic invasion were not noted in any of the patients. Frozen sections of the margins were taken until the tumor was cleared or until further tissue could not be resected without considerable morbidity. Negative margins were achieved in 16 patients, but 9 of those patients required reexcision to attempt to obtain negative margins during the primary resection. In 2 patients, negative margins were not obtained intraoperatively because of the extent of the tumor. One patient had a known positive mucosal margin and another had a known positive deep muscular margin. Two patients had missing data concerning margin status at the time of surgery. No patients were returned to the operating room because of a delayed detection of positive margins using permanent pathological techniques. Of the 20 patients, 19 had no reconstruction, and the resection site was allowed to heal by secondary intention. Reconstruction was performed for 1 patient with a radial forearm free flap.

Hospital Stay and Feeding Tube or Tracheostomy Tube Use

The mean hospital stay was 4.7 days (median, 3 days; range, 0-13 days). The duration of the hospital stay was determined primarily by the time at which the drains were removed after neck dissection. Ten patients underwent tracheostomy at the time of tumor resection. The mean duration of tracheostomy tube use was 6.3 days (median, 5.5 days; range, 2-11 days). All patients underwent decannulation before hospital discharge, and there were no known repeated tracheostomy procedures needed. Of the 20 patients undergoing treatment, 11 were discharged from the hospital able to swallow a modified soft diet. The other 9 were given a temporary nasogastric feeding tube that was removed after a mean of 16.2 days (median, 11 days; range, 2-51 days). Sixteen patients returned to a normal (oral) diet, whereas 1 patient was able to consume only a liquid diet. Temporary feeding tubes were removed from all patients, but 9 had a percutaneous endoscopic gastrostomy tube placed some time during the full course of treatment. Seven patients had these tubes removed (median duration, 181 days). One patient remained partially dependent and 1 patient remained completely dependent on the percutaneous endoscopic gastrostomy tube for nutritional supplementation. All patients included in the study communicated using intelligible oral speech, although 3 patients reported dysarthria that resolved in all cases.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Dataa</th>
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<tbody>
<tr>
<td>Sex</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>17 (85)</td>
</tr>
<tr>
<td>Female</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Age, y</td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>55.7</td>
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<tr>
<td>Median (range)</td>
<td>54.7 (38-73)</td>
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<td>White race</td>
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<tr>
<td>Tobacco use</td>
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<tr>
<td>Past</td>
<td>6 (30)</td>
</tr>
<tr>
<td>Never</td>
<td>9 (45)</td>
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<tr>
<td>Pack-years</td>
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</tr>
<tr>
<td>Mean</td>
<td>34.5</td>
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<tr>
<td>Median (range)</td>
<td>30 (0-76)</td>
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<tr>
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</tr>
<tr>
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<tr>
<td>Regular</td>
<td>9 (45)</td>
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<tr>
<td>1-2 Drinks/mo</td>
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<tr>
<td>1-2 Drinks/wk</td>
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<tr>
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<tr>
<td>Daily</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Unknown</td>
<td>3 (15)</td>
</tr>
</tbody>
</table>

a Unless otherwise indicated, data are expressed as number (percentage) of patients.
ADJUVANT THERAPY

Radiotherapy or chemoradiotherapy was offered postoperatively to patients with N2 or more severe neck disease, N1 lymph node metastasis with extracapsular spread, or evidence of lymphovascular invasion at the primary site. Table 3 outlines treatment modality by pathological stage. Sixteen patients completed adjuvant therapy, including RT in 12 and chemoradiotherapy in 4. Eleven patients had their postoperative treatment performed at our institution. The median dose of radiation administered was 60 Gy. All patients undergoing postoperative adjuvant RT finished their complete course of treatment. One of the 4 patients receiving chemotherapy did not finish the full treatment secondary to a pulmonary embolism.

COMPLICATIONS

In 3 patients, an orocervical or orocutaneous fistula developed that required postoperative wound care. All had complete resolution of the fistula. There were no reported postoperative hematomas needing surgical intervention. Other postoperative complications included trismus (2 patients; resolved in 1 and persisting in 1), lymphedema (2 patients), and decreased range of motion of the neck (3 patients; resolved with further therapy in 1 and persisting in 4). No intraoperative deaths or life-threatening bleeding incidents occurred. There were no deaths during hospitalization for surgery or during postoperative treatment. One patient had a pulmonary embolus during chemoradiotherapy. That patient finished RT, but further chemotherapy was stopped. There were no reports of osteonecrosis of the mandible after surgery and RT. Ten patients had xerostomia for longer than 2 years after completing RT. Other minor complications after surgery and adjuvant RT included altered taste, odynophagia, otalgia, and hypothyroidism.

DISEASE CONTROL

The number and location of recurrences and patient status at last follow-up are shown in Table 4. At last follow-up, 17 patients (85%) were alive without evidence of disease, 2 (10%) were dead of disease, and 1 (5%) was dead of unknown causes. The mean (SD) follow-up time after treatment was 3.3 (2.6) years (median 3.2 years). The overall survival and disease-specific survival curves are shown in Figure 1 and Figure 2, respectively. Two years after treatment, the local control rate was 83.6%, the regional control rate was 100.0%, and the distant control rate was 94.7%. The overall survival estimate was 90.0% at 2 years and 83.1% at 3 years. The most common and only site of local recurrence was in the contra-

### Table 3. AJCC Staging and Treatment

<table>
<thead>
<tr>
<th>Pathological AJCC Stage</th>
<th>Type of Treatment, No. of Patients</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Surgery Only</td>
<td>Surgery and RT</td>
</tr>
<tr>
<td>II</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>IVA</td>
<td>2</td>
<td>10</td>
</tr>
<tr>
<td>All stages</td>
<td>4</td>
<td>12</td>
</tr>
</tbody>
</table>

Abbreviations: AJCC, American Joint Committee on Cancer; RT, radiotherapy.

### Table 4. Recurrences and Status at Last Follow-up

<table>
<thead>
<tr>
<th>Variable</th>
<th>No. (%) of Patients</th>
</tr>
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<tbody>
<tr>
<td>Local recurrence (n=3)</td>
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<tr>
<td>Contralateral base of tongue</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Regional recurrence</td>
<td>0</td>
</tr>
<tr>
<td>Distant metastasis (n=2)</td>
<td></td>
</tr>
<tr>
<td>Lung</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Liver</td>
<td>1 (5)</td>
</tr>
<tr>
<td>Status at last follow-up (N=20)</td>
<td></td>
</tr>
<tr>
<td>Dead</td>
<td>3 (15)</td>
</tr>
<tr>
<td>Alive with no evidence of disease</td>
<td>17 (85)</td>
</tr>
</tbody>
</table>

Figure 1. Kaplan-Meier life table analysis shows overall survival (death from any cause). Patients underwent transoral resection of carcinoma of the base of the tongue with or without postoperative adjuvant therapy. The parenthetical numbers under the percentages represent the number of patients at risk at that point.

Figure 2. Kaplan-Meier life table analysis shows disease-specific survival (death from disease). Patients underwent transoral resection of carcinoma of the base of the tongue with or without postoperative adjuvant therapy. The parenthetical numbers under the percentages represent the number of patients at risk at that point.
Squamous cell carcinoma of the BOT can be treated with surgery, RT, chemoradiotherapy, or a combination, and the complexity of treatments can be confusing to patients and physicians. Historically, the main treatment options have been surgery and RT, alone or in combination. Recently, chemoradiotherapy in combination with RT has been espoused as a more useful and less functionally impairing treatment option. Eighty percent of our patients received their diagnosis elsewhere and had their main symptom on average for 4.3 months. Thus, many patients seeking care for BOT SCC at our institution have already received multiple opinions about treatment. Some indicate that they have been advised against surgical therapy because it is mutilating, is not organ preserving, and is associated with a high complication rate. Patients with any stage of BOT carcinoma are increasingly being advised to undergo chemoradiotherapy as the primary treatment, and they have been told that the expected 5-year survival rate is 50% or less. The overall prognosis is poor for a number of reasons, including delay in diagnosis, advanced stage at presentation, and increased overall age and poor general health at the time of diagnosis. The strong opinions of physicians and patients about ideal treatments make randomization of a sufficient number of patients challenging (a large cohort is needed to measure potentially small differences in outcomes). Consequently, retrospective studies still are the best resource for determining treatment outcomes of BOT cancer.

Roughly one-third of tongue cancers arise from the BOT. Our review of patients (95% with stage III or stage IV advanced disease) showed that the estimated 2-year local control and regional control rates were 83.6% and 100.0%, respectively. The estimated 2-year disease-specific survival rate was 94.7%, and the estimated 2-year overall survival rate was 90.0%. These results compare favorably with those of many published series reporting treatment of BOT carcinoma. Increasingly, more centers are using primary chemoradiotherapy, whereas the use of primary RT is decreasing and the rate of surgery is remaining stable. This treatment approach is based on the premise that oncologic locoregional control and survival rates are the same after surgery and RT compared with primary chemoradiotherapy, but that chemoradiotherapy offers better organ preservation.

Previous benchmarks for evidence-based counseling of patients was compiled by Parsons et al from 51 series reporting treatment of 6400 patients with oropharyngeal carcinoma. In that compilation, the locoregional control rate of BOT carcinoma for surgery with or without RT was 60%, and it was 69% for RT with or without neck dissection. The authors also reported 5-year cause-specific survival rates of 62% and 63% for surgery with or without RT and RT with or without neck dissection, respectively.

The addition of chemotherapy to RT has been proposed to increase disease control. Studies have shown improvement in locoregional control and survival when comparing chemoradiotherapy with RT alone, but the disease-specific survival rate for patients with advanced-stage oropharyngeal carcinoma often remains less than 50%. Calais et al reported a 3-year actuarial, disease-free survival rate of 31% for patients undergoing chemoradiotherapy for advanced-stage oropharyngeal carcinoma and 20% for patients undergoing RT alone. In another large series of patients with advanced oropharyngeal carcinoma who were treated with chemoradiotherapy, the 3-year, event-free survival rate was 59%, and the locoregional control rate was 82%. Weber et al described a large series of patients with BOT carcinoma who were treated with various surgical resection approaches with and without RT. Early primary tumors treated with surgery or RT had control rates of 83% and 89%, respectively. For advanced primary tumors, definitive RT produced a local control rate of 55% compared with 79% for surgery and postoperative RT. They also showed that, if primary control was obtained, the regional failure rate was less than 10%.

Overall, oropharyngeal SCC usually results in some of the lowest 2- and 3-year survival rates, showing 61.3% and 46.1% disease-specific survival, respectively, in the review by Hoffman et al of head and neck cancer. In our review, we sought to evaluate findings only in those patients who had accessible tumors that were resectable with a transoral approach. This ultimately eliminates a number of patients with BOT SCC because many present at a more advanced T stage, but it helps to set the stage and evaluate whether minimally invasive approaches and techniques are feasible and oncologically sound in properly selected patients. As we have reported previously, we believe (and agree with others) that transoral removal of tonsillar SCC is a superlative option for properly selected patients and seek to support the transoral approach for removal of at least early–T stage BOT SCC.

How do we explain the strong survival rates of our patients? One possibility may be the method used to select tumors for transoral removal. Neck dissection showed that most of our patients had a high overall cancer stage, with 95% stage III or stage IV disease, but 80% of the patients had T1 or T2 primary tumors. Advanced staging was largely a reflection of neck disease, not primary tumor growth, thus allowing for transoral resection. Frozen-section assessment of cancer margins on all primary sites also may offer a considerable survival benefit. Of our patients, 10 required at least 1 reexcision of the margin, and 6 required more than 3 intraoperative reexcisions. However, margins eventually were cleared for all but 2 patients, and the rate of reexcision underscores the difficulty of determining tumor extent visually. Appreciation of tumor boundaries is much more difficult with transoral laser because
the surgeon loses some tactile appreciation of the tumor. The frozen-section pathologist is thus crucial to this procedure. In most cases in which additional margin specimens were taken, the tissue appeared grossly normal but it was microscopically involved with tumor. Because most patients have negative margins after tumor excision, we do not have to rely on adjuvant treatment to adequately control residual disease at the primary site. With complete tumor resection (confirmed by negative margins on frozen-section analysis) and neck dissection, our goal is complete removal of gross and microscopic disease before RT is initiated.

Our results might also be explained by our treatment approach, which includes carefully assessing the extent of neck disease, sampling the retropharyngeal nodes, and prescribing additional therapy to a specific group of high-risk patients. Carcinoma of the BOT will metastasize to the opposite side of the neck. Our policy has been to dissect ipsilateral N0 disease, to radiate ipsilateral N1 or more severe disease and contralateral N0 disease in node-positive disease, and to dissect both sides of the neck if there is palpable or radiographically suspected disease in the contralateral side. This treatment appears rational because the likelihood of having contralateral positive disease is low if the findings in the ipsilateral neck are negative, and the ability of RT to treat the N0 neck at high risk for disease is adequate. The absence of delayed disease in the neck after therapy is a testament to this treatment philosophy. Primary RT is less effective at controlling bulky disease as the stage increases, and removal of bulky disease before RT may offer a survival advantage.

Our multidisciplinary treatment center with efficient systems and communication strives to expedite patient care. We generally attempt to achieve tumor assessment and staging, patient counseling, and treatment initiation within 1 or 2 days after the initial patient consultation; thus, the tumor cannot progress considerably during the treatment-planning stage.

Nonoperative treatment of head and neck carcinoma is commonly termed organ preservation therapy. Although this term was originally used to describe laryngeal preservation therapy, it has crept into the treatment language of other head and neck cancers. When considering BOT cancer therapy, organ preservation may be misleading because preservation of a cancerous limited portion of the overall BOT, especially in the setting of T1 or T2 disease, may not be beneficial or desirable from a functional or oncologic standpoint. Furthermore, many organ preservation regimens have been associated with a substantial increase in cost when compared with standard therapies (higher costs are attributable to increased treatment-related adverse events).

Preservation of function is the real outcome measure. For an oncologic treatment in BOT cancer, speech, respiration, and swallowing are the common functions at risk during treatment. Our permanent tracheostomy tube rate (0%) and permanent feeding tube rate (10%) compare favorably with those of other modern series of treatment for oropharyngeal carcinoma in which the permanent gastrostomy tube requirement has reached as high as 51%. The percentage of our patients who returned to a normal diet (90%) is a testament to the preservation of function, even when a large portion of the BOT is resected. This compares well with the experience with conservative surgery in the management of T1 and T2 oropharyngeal SCC reported by Watkinson et al. In their study, 18 patients underwent excision, including excision of the tonsils in 14 and of the BOT in 4. Two of the patients with BOT cancer received lateral pharyngotomy for resection. The authors noted that all patients were eating and drinking normally before discharge, with a mean hospital stay of 4.9 days. Further functional assessment was performed with validated quality-of-life questionnaires, which showed that 75% of patients had a high/healthy level of general functioning after conservation surgery.

We believe that our high functional rates are attributable to several surgical and postsurgical strategies. We perform select or modified neck dissection whenever possible, and preserving the accessory and sensory nerves promotes functional recovery. Various technologies (e.g., transoral laser treatment) allow minimally invasive access to the tumors while improving visualization and providing excellent preservation of surrounding tissue. We allow most defects to heal by secondary intention because a contracted wound site that is covered by mucosalized tissue sometimes functions better (for speech and swallowing) than an insensate and bulky reconstructive flap. We avoid performing tracheostomies whenever possible, and when an airway must be placed, we attempt to downsize the tube early and occlude it as soon as tolerated in an attempt to remove it as early as possible. We also recognize that 80% of our patients had early T1 or T2 primary tumors, allowing for attempted transoral resection and likely contributing greatly to overall oncologic and functional outcomes.

Finally, 20% of patients can be treated successfully with only 1 type of therapy. This lessens the treatment-related scarring and xerostomia that interferes with speech and swallowing, and the considerably shorter treatment time hastens a full recovery. In addition, those who undergo RT are given a median dose of 63 Gy for treatment. This lessens the overall radiation exposure for those patients compared with patients at many other centers that prefer primary chemo-radiotherapy with protocols as high as 70 Gy to the treatment sites.

Our major intraoperative complication rate and operative fatality rate (5% and 0%, respectively) also compared favorably with those of other treatments. Surgical management of BOT carcinoma has waned in popularity, whereas chemoradiotherapy as a primary treatment has increased by approximately 15% in the past decade. One reason for this paradigm shift in treatment is the perception that surgery, compared with other treatments, is associated with increased morbidity. In the study by Parsons et al, surgery was associated with a severe complication rate of 23% and a fatality rate of 3%, whereas the respective rates for RT were 6% and 0.8%. Some organ preservation studies have even reported treatment-related death rates as high as 4%. Other authors in modern series have reported low numbers of major complications and low operative mortality rates (similar to
our study findings) for transoral resection of oropharyngeal cancer. One reason for the discrepancy between current surgical complication rates and those of older series is that the treatment of oral and oropharyngeal carcinoma has improved with advances in surgical techniques, equipment, RT regimens, and combined treatment regimens. Many benchmarks for surgical outcomes cite data published 15 to 20 years ago and describe techniques practiced 20 to 50 years ago. In most of those series, surgical options would not have included transoral procedures but would have included more radical procedures (eg, mandibulotomy would have been common).

Transoral surgical resection of appropriately selected, primarily early–T stage BOT carcinoma is a rational treatment recommendation for patients because it often does not involve lengthy surgical reconstruction and rehabilitation, and the treatment can be intensified with the addition of adjuvant chemotherapy or RT (or both) as tumor aggressiveness and stage dictate. The highest rate of secondary primary tumors in the head and neck occur in the oral cavity and oropharynx (up to 27% in some series). Use of RT as a primary treatment for small oropharyngeal tumors potentially decreases its effectiveness on second primary tumors; subsequent tumors may require ablative surgery (a procedure more destructive than initial resection). Our treatment approach potentially preserves the option of using other therapies if second primary tumors develop.

**CONCLUSIONS**

Evidence-based evaluation of treatments for BOT carcinoma should consider oncologic, functional outcomes, and the use of resources. This study provides oncologic and functional outcomes of treatment in patients with overall advanced–stage BOT SCC treated with primary transoral surgical excision. For patients with BOT cancers amenable to transoral resection, this is a rational treatment option that combines exceptional local control, regional control, and survival benefit while simultaneously optimizing function, minimizing complications, and limiting treatment to what is essential to maximize results. As surgical techniques and equipment continue to improve, we believe that transoral resection will continue to be a superlative option for patients with BOT SCC and should be considered a real alternative to chemoradiotherapy for early primary disease.

Submitted for Publication: May 20, 2009; final revision received August 10, 2009; accepted September 15, 2009.

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**Author Contributions:** Drs Henstrom, Moore, and Olsen had full access to all the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Henstrom, Moore, and Kasperbauer. Acquisition of data: Henstrom. Analysis and interpretation of data: Moore, Olsen, and McGree. Drafting of the manuscript: Henstrom and Moore. Critical revision of the manuscript for important intellectual content: Henstrom, Moore, Olsen, Kasperbauer, and McGree. Statistical analysis: McGree. Obtained funding: Henstrom. Study supervision: Moore, Olsen, and Kasperbauer.

**Financial Disclosure:** None reported.

**Funding/Support:** This study was supported by Mayo Clinic.

**Previous Presentation:** This study was presented at the American Head and Neck Society 2009 Annual Meeting; May 31, 2009; Phoenix, Arizona.

**Additional Contributions:** Amy L. Weaver, MS, Division of Biomedical Statistics and Informatics, Mayo Clinic, assisted with preparation of the manuscript.

**REFERENCES**


