Indications and techniques of surgery for the primary treatment of HNSCC

Prof. Christian Simon
Chef-de-service
Service d’ORL et chirurgie cervico-faciale
Centre Hospitalier Universitaire Vaudois (CHUV)
Université de Lausanne
Lausanne, Suisse
DISCLOSURE:

- PFIZER: TRIAL STEERING COMMITTEE
- MERCK: CONSULTANT
Oral cavity cancer

Indications
Current treatment guidelines

Buccal mucosa, floor of mouth, anterior tongue, alveolar ridge, retromolar trigone, hard palate

**CLINICAL STAGING**
- Resection of primary (preferred) ± ipsilateral (guided by tumor thickness) or bilateral (guided by location of primary) neck dissection or SLN biopsy
- T1-2, N0

**TREATMENT OF PRIMARY AND NECK**
- SLN identification successful
  - SLN pN0
  - SLN pN+
- SLN identification unsuccessful
  - Neck dissection

**ADJUVANT TREATMENT**
- No positive nodes and No adverse features
  - Consider RT
  - Systemic therapy/RT (category 1)
- One positive node without adverse features
  - Re-resection, if feasible or RT
  - Consider systemic therapy/RT
- Adverse features
  - Positive margin
  - Other risk factors

**FOLLOW-UP**
- Follow-up (See FOLL-A)
- Recurrent or persistent disease (See ADV-3)

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Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.
Current treatment guidelines

Buccal mucosa, floor of mouth, anterior tongue, alveolar ridge, retromolar trigone, hard palate

**CLINICAL STAGING**

- T3, N0; T1-3, N1-3; T4a, Any N
  - Surgery
  - Clinical trials

**TREATMENT OF PRIMARY AND NECK**

- N0, N1, N2a-b, N3
  - Resection of primary, ipsilateral, or bilateral neck dissection

- N2c (bilateral)
  - Resection of primary and bilateral neck dissection

**ADJUVANT TREATMENT**

- No adverse features
  - Consider RT

- Extracapsular extension ± positive margin
  - Systemic therapy/RT (category 1)

- Adverse features
  - Positive margin
    - Systemic therapy/RT (category 1)
    - Re-resection, if feasible and consider RT if negative margins

- Other risk features
  - RT
  - Consider systemic therapy/RT

**FOLLOW-UP**

- Follow-up (See FOLL-A)
  - Recurrent or persistent disease (See ADV-3)

---

6 See Principles of Surgery (SURG-A).
6 See Principles of Radiation Therapy (OR-A).
1 Adverse risk features: extracapsular extension, positive margins, pT3 or pT4 primary, N2 or N3 nodal disease, nodal disease in levels IV or V, perineural invasion, vascular embolism, lymphatic invasion (See Discussion).
6 See Principles of Systemic Therapy (CHEM-A).

Note: All recommendations are category 2A unless otherwise indicated.
Clinical Trials: NCCN believes that the best management of any patient with cancer is in a clinical trial. Participation in clinical trials is especially encouraged.
Treatment options for OCSCC: Surgery is preferred, but RT/CRT is an option

Fujiwara et al. Oral Oncology 2017
Oral cavity cancer

Techniques
Surgical approaches to the oral cavity

Fig. 2. Surgical approaches for excision of oral cancer: (a) peroral, (b) mandibulotomy, (c) lower cheek flap, (d) visor flap, and (e) upper cheek flap.

Surgical approach: TLM
Surgical approach: TLM

FIGURE 1. Kaplan–Meier curves for local control (LC), disease-specific survival (DSS), recurrence-free survival (RFS), and overall survival (OS). [Color figure can be viewed in the online issue, which is available at wileyonlinelibrary.com.]

Sinha et al., Head and Neck; 2013
The median mandibulotomy (Kocher, 1912)
Surgical approach: Compartmental tongue resection

Fig. 3. Left panel: coronal view of hemi-tongue compartments; Right Panel: sagittal view of hemi-tongue compartment – Note: hypoglossal nerve in relation to hyoid bone (dotted line).

Calabrese et al. Oral Oncology 2011

Calabrese et al.
Acta Otorhinolaryngol Ital.; 2009
ASCO clinical practice guidelines for the management of the neck

FIG 2. Treatment algorithm for management of the neck in patients with oral cavity squamous cell carcinoma (SCC) of the head and neck. cN0, clinically node negative; cN+, clinically node positive; END, elective neck dissection; pN1, single pathologically node positive.
Management of the N0-neck: Elective ND vs. therapeutic ND (wait-and-see)

Meta-analysis on efficacy of sentinel node biopsy

Figure 5 Forest plot oral cavity cancers.

Govers et al. Oral Oncology 2013
Cost-utility of sentinel lymph node biopsy

N. van der Linden et al. Oral Oncology 53 (2016) 20–26

Fig. 4. Cost-utility planes and cost-utility acceptability curves for the four strategies, per time horizon.

Van der Linden et al. Oral Oncology 2016
Free flap reconstruction of the tongue with a RFF
Hemi-tongue reconstruction with RFF

• Video removed for online publishing
Reconstruction of the anterior ¾ of the tongue
Near total tongue resection for a cT4cN1M0 tongue SCC

- Video removed for online publishing
Near-total tongue resection after RT for a recurrent rT4rN0M0-tongue SCC

- Video removed for online publishing
Reconstruction of the mandible: 3D-planning
Reconstruction of the mandible: 3D-planning
Reconstruction of the mandible: 3D-planning
Oropharyngeal Cancer

Indications
HPV positive oropharyngeal cancers have a better prognosis

Ang et al. New Engl J Med 2010
8th AJCC clinical staging for HPV-positive OPC

**Figure 4:** Proposed ICON-S stage tabulation grid for 8th edition TNM
Note that distant metastatic disease (M1) is considered stage IV.

O’Sullivan Lancet Oncology 2016
Treatment options based on stage

AJCC 8th edition

• Stage 1:
  – RT vs. Surgery vs. Surgery + RT/CRT vs. CRT

• Stage 2:
  – CRT vs. Surgery + CRT (rarely +RT)

• Stage 3:
  – CRT vs. Surgery + CRT
Oropharyngeal Cancer

Techniques
Open approach to the oropharynx: Lateral pharyngotomy

Masuda et al. Auris Nasus Larynx 2011
Open approach to the oropharynx: Median mandibulotomy
BOT-resection, hemi-glossectomy, segmental mandible resection for recurrent BOT cancer after CRT

- Video removed for online publishing
Types of trans-oral surgery (TOS)

– Conventional trans-oral approach

– Trans-oral robotic surgery (TORS)

– Trans-oral laser microsurgery (TLM)
Differences between TLM and TORS

**TLM**
- microscope

**TORS**
- Robot with endoscope
Resection of a tonsil cancer

- Video removed for online publishing
Experience with TORS in patients with T1-2 N0-2b (7th AJCC) OPCs
## Functional outcome with TORS/TLM and adjuvant (C)RT

<table>
<thead>
<tr>
<th>Study</th>
<th>TORS/TLM</th>
<th>TNM</th>
<th>Adj. tx</th>
<th>Functional outcome 1Y</th>
</tr>
</thead>
<tbody>
<tr>
<td>Morisod 2017</td>
<td>TORS</td>
<td>T1-2/N0-2c (No ECS, 45% secondary primaries)</td>
<td>CRT 3% / RT 28%</td>
<td>FOSS back to 0-2 in 70%</td>
</tr>
<tr>
<td>Choby 2015</td>
<td>TORS</td>
<td>T1-3/N0-2c</td>
<td>CRT 0% / RT 0%</td>
<td>UW_QOL for swallowing at 100/100</td>
</tr>
<tr>
<td>Chen 2014</td>
<td>TORS/TLM</td>
<td>T1-3/N1-2c</td>
<td>RT 100%</td>
<td>UW_QOL for swallowing at 91.5/100</td>
</tr>
<tr>
<td>Sinclair 2011</td>
<td>TORS</td>
<td>T1-2/N0-2c</td>
<td>CRT 31% / RT 45%</td>
<td>MDADI from pre-tx 82 to post-tx 74</td>
</tr>
<tr>
<td>Genden 2011</td>
<td>TORS</td>
<td>T1-2/N0-2c</td>
<td>CRT 60% / RT 20%</td>
<td>PSS-HN and FOIS back to baseline</td>
</tr>
<tr>
<td>Leonhardt 2012</td>
<td>TORS</td>
<td>T1-4/N0-2b</td>
<td>CRT 19% / RT 60%</td>
<td>PSS-HN back to baseline for diet and eating, reduced for speech</td>
</tr>
<tr>
<td>More 2012</td>
<td>TORS</td>
<td>T1-3/N0-2c</td>
<td>CRT 60% / RT 20%</td>
<td>MDADI back to baseline</td>
</tr>
<tr>
<td>Haughey 2011</td>
<td>TLM</td>
<td>T1-4/N0-3</td>
<td>CRT 16% / RT 58%</td>
<td>FOSS back to 0-2 in 87%</td>
</tr>
<tr>
<td>Grant 2006</td>
<td>TLM</td>
<td>T1-4/N0-3</td>
<td>CRT 0% / RT 47%</td>
<td>FOSS back to baseline</td>
</tr>
</tbody>
</table>
Novel robotic surgery platforms

- Intuitive Surgical (ENT)
  - XI, SP
- MedRobotics (ENT)
- Medineering (ENT – endoscopic sinus surgery)
- Galen Robotics (“SurgRob”) (ENT)
- Titan Medical (“Sport”) (Abdominal)
- Cambridge Medical Robotics (“Versius”) (Abdominal)
- TransEnterix (“Senhance”) (Abdominal)
- VERB Surgical (Abdominal)
Intuitive Surgical daVinci SP

• Video removed for online publishing
The Medrobotics system
Medineering

- Video removed for online publishing
Galen Robotics

• Video removed for online publishing
Titan Medical

- Video removed for online publishing
Cambridge Medical Robotics
“Versius”

• Video removed for online publishing
TransEnterix “Senhance”

• Video removed for online publishing
Laryngeal and hypopharyngeal cancer

Indications
Current treatment guidelines: Larynx (NCCN)

Amenable to larynx-preserving (conservation) surgery (T1-T2, N0 or select T3, N0)\(^g\)

- RT\(^h\)
- or
- Partial laryngectomy/ endoscopic or open resection\(^i\) as indicated and neck dissection as indicated

T3 requiring (amenable to) total laryngectomy (N0-1)

- or
- N0
- Surgery\(^i\)
- or
- N1
- Induction chemotherapy\(^k,m\)
- or
- Clinical trials

Concurrent systemic therapy/RT\(^h,k,l\) or RT\(^h\) if patient not candidate for systemic therapy/RT
Current treatment guidelines (NCCN)

T3 requiring (amenable to) total laryngectomy (N2-3)

- Concurrent systemic therapy/RT\textsuperscript{h,k,l}
  - or
  - Surgery\textsuperscript{i}
    - or
    - Induction chemotherapy\textsuperscript{k,m}
      - or
      - Clinical trials

T4a, N0-3 → Surgery\textsuperscript{i} → N1 →

N2-3 →
Current treatment guidelines: Hypopharynx (NCCN)

- Total laryngopharyngectomy + neck dissection + hemi- or total thyroidectomy, after ipsilateral or bilateral paratracheal lymph node dissection

  - Total laryngopharyngectomy + neck dissection + hemi- or total thyroidectomy, after ipsilateral or bilateral paratracheal lymph node dissection

  - Other risk features

- Systemic therapy/RT (category 1)

- Follow-up (See FOLL-A)

- Recurrent or persistent disease (See ADV-3)

- T4a, any N

- Induction chemotherapy (category 3)

- CT or MRI (with contrast) of primary and neck

- See Response Assessment (HYPO-6)

- Concurrent systemic therapy/RT (category 3)

  - See Follow-Up Recommendations Post Chemoradiation or RT (FOLL-A, 2 of 2)

  - Recurrent or persistent disease (See ADV-3)

- Clinical trial
Laryngeal and Hypopharyngeal cancer

Techniques
What if the larynx cannot be preserved surgically

- Laryngeal cartilage infiltration (T4a)
- Crico-arytenoid joint infiltration
- Post-cricoid and inter-arytenoid involvement
Options for the reconstruction of total laryngo-pharyngectomy defects

1. Gastric pull-up
2. Jejunum
3. RFF, ALT
Circular pharyngeal reconstruction
What if the larynx **can** be preserved surgically

- **NO** laryngeal cartilage infiltration
  - **NO** crico-arytenoid joint infiltration
  - **NO** post-cricoid and inter-arytenoid involvement
Laser surgery for the larynx
Principles of laser surgery

- Video removed for online publishing
Transorale Laserchirurgie
Transorale Laserchirurgie
Robotic surgery for the supraglottic larynx

- 18 pts. treated with TORS-SL
- Mean f/u 28.1 months
- 0% tracheostomy/PEG
- 2-year LRC, DSS, OS were 83%, 100%, 89% resp.

Mendelsohn et al.; Head and Neck 2013
Open laryngeal framework surgery

- Supracricoid partial laryngectomy with CH(E)P:
  - T2/T3 laryngeal cancer:
    5-year LCR 96%-100%
    (Sperry et al. JAMA Otolaryngol Head Neck Surg. 2013)
CUP-Syndrome
Data on TORS/TLM and CUP

### Table 4: Overall identification rate of unknown primary with TORS/TLM

<table>
<thead>
<tr>
<th>Author</th>
<th>Method</th>
<th>Proportion Identified with TORS/TLM</th>
<th>Proportion Identified with lingual tonsillectomy using TORS/TLM</th>
<th>Proportion Identified with palatine tonsillectomy using TORS/TLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abuzaid et al. [26]</td>
<td>TORS</td>
<td>1/1 (100 %)</td>
<td>1/1 (100 %)</td>
<td>0/0 (0 %)*</td>
</tr>
<tr>
<td>Blanco et al. [28]</td>
<td>TORS</td>
<td>1/4 (25 %)</td>
<td>0/4 (0 %)</td>
<td>1/4 (25 %)</td>
</tr>
<tr>
<td>Durmus et al. [18]</td>
<td>TORS</td>
<td>17/22 (77 %)</td>
<td>4/14 (29 %)</td>
<td>13/17 (76 %)</td>
</tr>
<tr>
<td>Kani et al. [16]</td>
<td>TLM</td>
<td>17/18 (94 %)</td>
<td>11/18 (61 %)</td>
<td>6/18 (33 %)</td>
</tr>
<tr>
<td>Mehta et al. [19]</td>
<td>TORS</td>
<td>9/10 (90 %)</td>
<td>9/10 (90 %)</td>
<td>0/3 (0 %)</td>
</tr>
<tr>
<td>Mourad et al. [27]</td>
<td>TORS</td>
<td>1/1 (100 %)</td>
<td>1/1 (100 %)</td>
<td>0/1 (0 %)</td>
</tr>
<tr>
<td>Nagel et al. [17]</td>
<td>TLM</td>
<td>31/36 (86 %)</td>
<td>13/19 (68 %)</td>
<td>-</td>
</tr>
<tr>
<td>Patel et al. [15]</td>
<td>TORS</td>
<td>34/47 (72 %)</td>
<td>21/41 (51 %)</td>
<td>14/27 (52 %)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>TORS/TLM</strong></td>
<td><strong>111/139 (80 %)</strong></td>
<td><strong>60/108 (56 %)</strong></td>
<td><strong>34/70 (49 %)</strong></td>
</tr>
</tbody>
</table>

*Patient had childhood tonsillectomy  
Seven of ten patients had childhood tonsillectomy  
One patient had synchronous lingual/palatine tonsil tumors

### Table 3: Post-operative pathologic findings after TORS.

<table>
<thead>
<tr>
<th>Site of Disease</th>
<th>Identified (n = 26)</th>
<th>Unknown (n = 9)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base of Tongue (BOT)</td>
<td>12 (46.1%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Tonsil</td>
<td>11 (42.3%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Both BOT &amp; Tonsil</td>
<td>2 (7.7%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Glossotonsillar sulcus</td>
<td>1 (3.8%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Margin Status</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clear</td>
<td>22 (84.6%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Positive</td>
<td>4 (15.4%)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Extracapsular Spread</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Positive</td>
<td>10 (38.5%)</td>
<td>3 (33.3%)</td>
<td>13 (37.1%)</td>
</tr>
<tr>
<td>Negative</td>
<td>12 (46.1%)</td>
<td>4 (44.4%)</td>
<td>16 (45.7%)</td>
</tr>
<tr>
<td>Unknown</td>
<td>4 (15.4%)</td>
<td>2 (22.2%)</td>
<td>6 (17.1%)</td>
</tr>
</tbody>
</table>


Patel et al. Oral Onc. 2017
Resection of the lingual tonsil

- Video removed for online publishing
Bilateral robotic-assisted neck dissection

Unpublished data
Robot-assisted neck dissection

- Video removed for online publishing
Bilateral robotic-assisted neck dissection
Thank you for your attention
Epidemiology of laryngeal cancer:
The GLOBOCAN project
Epidemiology of hypopharyngeal cancer

• Incidence of hypopharyngeal cancers in Sweden (1960-1989) 1.22/100000 for men, 0.45/100000 for women (Wahlberg et al. in Cummings – Otolaryngology 2010)

• Incidence of hypopharyngeal cancers in the UK 0.63/100000 (Pracy et al. in Cummings – Otolaryngology 2010)

• Similar numbers from SEER-database (SEER 2013)
Epidemiology – oral cavity cancer (OCSCC)

- 28030 new cases of OCSCCs in the US in 2014
- 12170 deaths occurring annually
- Risk factors are cigarette use (3 fold increase), concomitant alcohol consumption (10-15 fold increase)

Fig 1. Age-adjusted incidence of squamous cell carcinoma of the oral tongue by calendar year 1975 to 2007. APC, annual percentage change. (*) Value is statistically significant with $P < .05$; (1) value is not statistically significant with $P > .05$.

Patel et al. JCO 2011
Epidemiology of oroparyngeal cancer

• Incidence of oropharyngeal cancer (OPC) in the US is 2.2/100,000 in 2009 (SEER 2013)

• Early stage OPC between 16.5% and 26% of all OPCs (Carvalho 2005)
Epidemiology: HPV and oropharyngeal cancer (US)

- Population level incidence /100,000 of HPV positive OPC increased from 0.8 (1988) to 2.6 (2004) corresponding to an increase of 225%.
- Incidence of HPV negative OPC declined by 50%.

Chaturvedi et al. JCO 2011
The development of laryngeal preservation approaches: Non-surgical

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of Patients (accrual period)</th>
<th>Site</th>
<th>Stage</th>
<th>Treatment</th>
<th>Response of Primary to Induction Chemotherapy</th>
<th>Larynx Preservation</th>
<th>Overall Survival</th>
</tr>
</thead>
</table>
| VALCSG      | 332 (1985-1988)                  | Larynx SG (63%)
G (37%) | III (57%)\(a\)
IV (43%)   | a) TL → RT
b) PF × 3 → RT\(b\) | NA                  | NA     | 3-year, 5-year  |
| RTOG 91-11  | 547 (1992-2000)                  | Larynx SG (69%)
G (31%)   | III (64%)\(a\)
IV (36%)\(a\)  | a) PF × 3 → RT\(b\)
b) RT + P
 c) RT   | 85% CR + PR                      | NA     | 5-year, 10-year |
| EORTC 24954-22950 | 450 (1996-2004)        | Larynx (48%)
Hyropharynx (52%) | II (4%)
IV (39%)
IV (58%) | a) PF × 4 → RT (70 Gy)\(b\)
b) PF alternating/RT (60 Gy) | 89% CR + PR | NA | 3-year \(a\)
|                      |                                |                      |         |                 |                               |                     | 3-year           |
| GORTEC 2000-01   | 213 (2000-2005)                 | Larynx (46%)
Hyropharynx (54%) | III, IV   | a) PF × 3 → RT\(n\)
b) TPF × 3 → RT\(b\) | 59.2% CR + PR  | NA     | 3-year           |
| EORTC 24891     | 202 (1986-1993)                 | Hyropharynx         | II (7%)
III (57%)
IV (37%)\(k\) | a) TLP → RT
b) PF × 3 → RT\(i\) | 54% CR | NA | 3-year, 10-year |

Abbreviations: CR, complete response; EORTC, European Organisation for Research and Treatment of Cancer; G, glottic; GORTEC, Groupe Oncologie Radiotherapie de la Tete et du Cou; NA, not applicable; P, cisplatin; PF, cisplatin plus fluorouracil; PR, partial response; RT, radiation therapy; RTOG, Radiation Therapy Oncology Group; SG, supraglottic; TL, total laryngectomy; TLP, total laryngectomy with partial pharyngectomy; TPF, docetaxel plus cisplatin plus fluorouracil; VALCSG, Veterans’ Administration Laryngeal Cancer Study Group.

Forastiere et al.; JCO 2015
Results with TLM for T2-T4 glottic and supraglottic disease

### Table 2: Oncological Results of TLM in Advanced Tumours in a Glottic Location (T2–T4).

<table>
<thead>
<tr>
<th>Author</th>
<th>No.</th>
<th>TNM stage</th>
<th>Tr</th>
<th>Local control with laser 5 y.</th>
<th>Final local control 5 y.</th>
<th>Specific sv. 5 y.</th>
<th>Overall sv. 5 y.</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steiner W, 1993</td>
<td>81</td>
<td>T2–T4</td>
<td>TLM±LND±RDT</td>
<td>78%</td>
<td>-</td>
<td>-</td>
<td>59%</td>
<td>G (51)+S (30)</td>
</tr>
<tr>
<td>Ambrosch P, 2001</td>
<td>167</td>
<td>T2b–T3N0</td>
<td>TLM</td>
<td>74% (T2b), 68% (T3)</td>
<td>87% in both groups</td>
<td>62%</td>
<td>-</td>
<td>G</td>
</tr>
<tr>
<td>Davis RK, 2004</td>
<td>13</td>
<td>T2b</td>
<td>TLM+RDT</td>
<td>66%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>G</td>
</tr>
<tr>
<td>Motta G, 2005</td>
<td>51</td>
<td>T3</td>
<td>TLM</td>
<td>65%</td>
<td>-</td>
<td>72%</td>
<td>64%</td>
<td>G</td>
</tr>
<tr>
<td>Hinni ML, 2007</td>
<td>117</td>
<td>T2–T4</td>
<td>TLM±adjuvant RDT</td>
<td>45%</td>
<td>-</td>
<td>55%</td>
<td>G (42)+S(75)</td>
<td></td>
</tr>
<tr>
<td>(multicentre)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grant DG, 2007</td>
<td>10</td>
<td>T3–T4</td>
<td>TLM±adjuvant RDT</td>
<td>{66%} (45%)</td>
<td>{90%} (62%)</td>
<td>-</td>
<td>G</td>
<td></td>
</tr>
<tr>
<td>Peretti G, 2010</td>
<td>11</td>
<td>T3</td>
<td>TLM</td>
<td>71.6%</td>
<td>-</td>
<td>100%</td>
<td>-</td>
<td>G</td>
</tr>
<tr>
<td>Vilaseca I, 2010</td>
<td>51</td>
<td>T3</td>
<td>TLM</td>
<td>47.1%</td>
<td>88.2%</td>
<td>86.3%</td>
<td>73.1%</td>
<td>G</td>
</tr>
<tr>
<td>Blanch JL, 2011</td>
<td>26</td>
<td>T3</td>
<td>TLM</td>
<td>-</td>
<td>-</td>
<td>80.4%</td>
<td>-</td>
<td>LAC</td>
</tr>
</tbody>
</table>

G: glottis; LAC: laryngeal anterior commissure; LND: lymph node dissection; No.: number of patients; RDT: radiotherapy; S: supraglottis; Sv: survival; TLM: transoral laser microsurgery.

5-years OS 55% - 73%

### Table 3: Oncological Results of TLM in Advanced Tumours (T3–T4) in a Supraglottic Location.

<table>
<thead>
<tr>
<th>Author</th>
<th>No.</th>
<th>TNM stage</th>
<th>Tr</th>
<th>Local control with laser 5 y.</th>
<th>Final local control 5 y.</th>
<th>Specific sv. 5 y.</th>
<th>Overall sv. 5 y.</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iro, 1998</td>
<td>48</td>
<td>T3–T4</td>
<td>TLM±LND±RDT</td>
<td>83.3%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Rudert, 1999</td>
<td>17</td>
<td>T3–T4</td>
<td>TLM±LND±RDT</td>
<td>83.3%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Ambrosch, 2001</td>
<td>50</td>
<td>T3</td>
<td>LND±LND±RDT</td>
<td>77%</td>
<td>96%</td>
<td>71%</td>
<td>81%</td>
<td>G</td>
</tr>
<tr>
<td>Motta, 2004</td>
<td>18</td>
<td>T3</td>
<td>TLM</td>
<td>77%</td>
<td>81%</td>
<td>81%</td>
<td>81%</td>
<td></td>
</tr>
<tr>
<td>Davis RK, 2004</td>
<td>46</td>
<td>T2(28) T3(18)</td>
<td>TLM+RDT</td>
<td>97%</td>
<td>-</td>
<td>-</td>
<td>63%</td>
<td></td>
</tr>
<tr>
<td>Grant, 2007</td>
<td>10</td>
<td>T3–T4</td>
<td>TLM±LND±RDT</td>
<td>T3: [100%] T4: (80%)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Cabanillas R, 2008</td>
<td>15</td>
<td>T3</td>
<td>TLM±LND±RDT</td>
<td>70%</td>
<td>-</td>
<td>80%</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>Vilaseca, 2010</td>
<td>96</td>
<td>T3</td>
<td>TLM±LND±RDT</td>
<td>69.8%</td>
<td>91.7%</td>
<td>61.8%</td>
<td>45.8%</td>
<td></td>
</tr>
<tr>
<td>Peretti, 2010</td>
<td>20</td>
<td>T3</td>
<td>TLM±LND±CT-RDT</td>
<td>83%</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
</tbody>
</table>
| CT-RDT: chemo-radiotherapy; LND: lymph node dissection; No.: number of patients; RDT: radiotherapy; Sv: survival; TLM: transoral laser microsurgery; Tr: treatment; y.: years.

5-years OS 46% - 81%
# Functional results

<table>
<thead>
<tr>
<th>Author</th>
<th>No.</th>
<th>TNM stage</th>
<th>Location</th>
<th>Tr</th>
<th>Laryngeal preservation (%) 5 y.</th>
<th>LT-Free sv. 5 y.</th>
<th>Preservation of laryngeal function (%) 5 y.</th>
<th>Definitive gastrostomy, %</th>
<th>Definitive tracheotomy, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambrosch P, 2001²⁸</td>
<td>167</td>
<td>T2b–T3</td>
<td>G</td>
<td>TLM±LND±RDT</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>0.6%</td>
</tr>
<tr>
<td>Ambrosch P, 2001²⁸</td>
<td>50</td>
<td>T3</td>
<td>S</td>
<td>TLM±LND±RDT (neck)</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>2%</td>
</tr>
<tr>
<td>Motta G, 2004²⁹</td>
<td>18</td>
<td>T3</td>
<td>S</td>
<td>TLM</td>
<td>93.7%</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>–</td>
</tr>
<tr>
<td>Davis KR, 2004³²</td>
<td>46</td>
<td>T2 (28)</td>
<td>S</td>
<td>TLM+RDT</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Cabanillas R, 2004³⁶</td>
<td>15</td>
<td>T3</td>
<td>S</td>
<td>TLM±LND±RDT</td>
<td>86%</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Motta G, 2005³⁰</td>
<td>51</td>
<td>T3</td>
<td>G</td>
<td>TLM</td>
<td>80.5%</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>–</td>
</tr>
<tr>
<td>Hinull ML, 2007²⁷</td>
<td>117</td>
<td>T2–T4</td>
<td>G (n=41)+S (n=65)</td>
<td>TLM±RDT (34%)</td>
<td>{92%}</td>
<td>{70%}</td>
<td>–</td>
<td>7% among survivors</td>
<td>3% among survivors</td>
</tr>
<tr>
<td>Grant DG, 2007³⁴</td>
<td>38</td>
<td>T1–T4</td>
<td>S</td>
<td>TLM±LND±RDT</td>
<td>{97%}</td>
<td>{79%}</td>
<td>–</td>
<td>13%</td>
<td>0%</td>
</tr>
<tr>
<td>Grant DG, 2007³³</td>
<td>10</td>
<td>T3–T4</td>
<td>G</td>
<td>TLM±LND±RDT</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Olthoff A, 2009³⁸</td>
<td>39</td>
<td>Stage III–IV (T3–T4)</td>
<td>S+G</td>
<td>TLM+RDT±concomitant CT (6)</td>
<td>–</td>
<td>–</td>
<td>89.7%</td>
<td>30% of survivors</td>
<td>10% among the entire series 0% of survivors</td>
</tr>
<tr>
<td>Vilaseca I, 2010²³</td>
<td>51</td>
<td>T3</td>
<td>G</td>
<td>TLM±LND</td>
<td>–</td>
<td>58.9</td>
<td>51%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Vilaseca I, 2010²³</td>
<td>96</td>
<td>T3</td>
<td>S</td>
<td>TLM±LND±RDT</td>
<td>–</td>
<td>76.6</td>
<td>74.5%</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Peretti G, 2010¹⁷</td>
<td>11</td>
<td>T3</td>
<td>G</td>
<td>TLM</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Peretti G, 2010³⁴</td>
<td>20</td>
<td>T3</td>
<td>S</td>
<td>TLM±LND±CT-RDT</td>
<td>88.2%</td>
<td>–</td>
<td>–</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Blanch JL, 2011²⁰</td>
<td>26</td>
<td>T3</td>
<td>LAC</td>
<td>TLM±LND</td>
<td>–</td>
<td>65.5%</td>
<td>–</td>
<td>0%</td>
<td>0%</td>
</tr>
</tbody>
</table>

CT-RDT: chemo-radiotherapy; G: glottis; LAC: laryngeal anterior commissure; laryngeal preservation: % of laryngeal preservation estimated including only survivors; laryngectomy-free survival: % of surviving patients (regardless of cause) with a preserved larynx; LND: lymph node dissection; No.: number of patients; RDT: radiotherapy; S: supraglottis; Sv: survival; TLM: transoral laser microsurgery; Tr: treatment; y.: years.
What is new in TORS?

...many of the Intuitive Surgical patents will expire between now and 2022...
Surgery provides similar oncological outcome for advanced OPSCCs as radiation therapy...

### TABLE 3
Base of Tongue Carcinoma: Five-Year Survival

<table>
<thead>
<tr>
<th>Institution</th>
<th>No. of patients</th>
<th>T4 (%)</th>
<th>Stage IV (%)</th>
<th>Absolute</th>
<th>Cause specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>S with or without adjuvant RT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mayo Clinic, Rochester, MN (1960–1967) (1972)</td>
<td>102</td>
<td>ND</td>
<td>7</td>
<td>44</td>
<td>ND</td>
</tr>
<tr>
<td>Washington University, St. Louis, MO (1983)</td>
<td>101</td>
<td>9</td>
<td>45</td>
<td>45</td>
<td>ND</td>
</tr>
<tr>
<td>University of Pennsylvania, Philadelphia, PA (1997)</td>
<td>17</td>
<td>41</td>
<td>59</td>
<td>46 (3 yr)</td>
<td>ND</td>
</tr>
<tr>
<td>Weighted average</td>
<td>500</td>
<td>11</td>
<td>31</td>
<td>49</td>
<td>62</td>
</tr>
<tr>
<td>RT with or without neck dissection</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Memorial Medical Center, Long Beach, CA (1980)</td>
<td>70</td>
<td>17</td>
<td>57</td>
<td>35</td>
<td>60</td>
</tr>
<tr>
<td>University of Florida, Gainesville, FL (2000)</td>
<td>217</td>
<td>19</td>
<td>71</td>
<td>50</td>
<td>64</td>
</tr>
<tr>
<td>Weighted average</td>
<td>473</td>
<td>14</td>
<td>62</td>
<td>52</td>
<td>63</td>
</tr>
</tbody>
</table>

ND: no data.

*Modified from Table 3 in Mendell et al., 2000.*

Parsons et al., Cancer; 2002
...but the rate of severe complications is higher

<table>
<thead>
<tr>
<th>Institution</th>
<th>No. of patients</th>
<th>T4 (%)</th>
<th>Boost technique</th>
<th>Complications (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>S with or without adjuvant RT</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>M. D. Anderson Cancer Center, Houston, TX (1964–1973) (1976)</td>
<td>34</td>
<td>41</td>
<td>NA</td>
<td>26 18</td>
</tr>
<tr>
<td>Indiana University, Indianapolis, IN (1983)</td>
<td>8</td>
<td>36</td>
<td>NA</td>
<td>36 12</td>
</tr>
<tr>
<td>Washington University, St. Louis, MO (1983)</td>
<td>101</td>
<td>9</td>
<td>NA</td>
<td>28  4</td>
</tr>
<tr>
<td>Stanford University, Palo Alto, CA (1985)</td>
<td>14</td>
<td>0</td>
<td>NA</td>
<td>64  0</td>
</tr>
<tr>
<td>University of California, Los Angeles, CA (1990)</td>
<td>13</td>
<td>0</td>
<td>NA</td>
<td>23  0</td>
</tr>
<tr>
<td>University of Pittsburgh, Pittsburgh, PA (1992)</td>
<td>14</td>
<td>0</td>
<td>NA</td>
<td>0    0</td>
</tr>
<tr>
<td>Memorial Sloan-Kettering Cancer Center, New York, NY (1979–1989) (1993)</td>
<td>100</td>
<td>19</td>
<td>NA</td>
<td>ND  0</td>
</tr>
<tr>
<td>University of Pennsylvania, Philadelphia, PA (1997)</td>
<td>17</td>
<td>41</td>
<td>NA</td>
<td>26  0</td>
</tr>
<tr>
<td>Weighted average</td>
<td>407</td>
<td>15</td>
<td></td>
<td>32 3.5</td>
</tr>
<tr>
<td>RT with or without neck dissection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stanford University, Palo Alto, CA (1956–1973) (1976)</td>
<td>104</td>
<td>ND</td>
<td>EBRT</td>
<td>7    1</td>
</tr>
<tr>
<td>M. D. Anderson Cancer Center, Houston, TX (1954–1971) (1976)</td>
<td>174</td>
<td>17</td>
<td>EBRT</td>
<td>3    0</td>
</tr>
<tr>
<td>Memorial Medical Center, Long Beach, CA (1988)</td>
<td>70</td>
<td>17</td>
<td>192Ir</td>
<td>6    0</td>
</tr>
<tr>
<td>M. D. Anderson Cancer Center, Houston, TX (1974–1984) (1990)</td>
<td>121</td>
<td>ND</td>
<td>EBRT</td>
<td>2    0</td>
</tr>
<tr>
<td>M. D. Anderson Cancer Center, Houston, TX (1984–1992) (1995)</td>
<td>54</td>
<td>2</td>
<td>EBRT</td>
<td>0    0</td>
</tr>
<tr>
<td>William Beaumont Hospital, Royal Oak, MI (1996)</td>
<td>20</td>
<td>25</td>
<td>192Ir</td>
<td>10   0</td>
</tr>
<tr>
<td>Memorial Sloan-Kettering Cancer Center, New York, NY (1981–95) (1998)</td>
<td>68</td>
<td>3</td>
<td>192Ir</td>
<td>3    0</td>
</tr>
<tr>
<td>University of Florida, Gainesville, FL (2000)</td>
<td>217</td>
<td>19</td>
<td>EBRT</td>
<td>4    1</td>
</tr>
<tr>
<td>Weighted average</td>
<td>842</td>
<td>14</td>
<td></td>
<td>3.8 0.4</td>
</tr>
</tbody>
</table>

NA: not applicable; ND: no data; EBRT: external beam radiation therapy; 192Ir: iridium 192 interstitial brachytherapy boost; S: surgery; RT: radiation therapy.

* Modified from Table 1 in Mendenhall et al., 2006.