**Abstract**

**Introduction:** Total laryngectomy (TL) results in complete ablation of nasal airflow, with notable pathologic alterations of intranasal mucosa, mucociliary clearance, and nasal cycle. Despite these evident morphological changes, it remains unclear whether this subset population experiences clinically significant sinonasal disease. The goal of this study was to identify rhinosinusitis in TL patients using radiographic imaging.

**Methods:** An IRB-approved retrospective review (January 2005–July 2017) identified 50 patients who underwent radiographic imaging before and after TL. The Lund-Mackay Staging System (LM) was applied to 197 surveillance Computed Tomography scans. Simple linear regression was modeled to LM; tests of statistical significance were examined via the method of Kenwood and Roger. Demographic as well as relevant clinical factors were also analyzed.

**Results:** The mean age was 62.4 years, with a 5:1 male-to-female ratio. A series of abstracted rhinologic associated comorbidities include acid reflux (50%), allergic rhinitis (2%), asthma (8%), chronic rhinosinusitis (10%), radiation therapy (56%), and tobacco use (24%). A median of 3 scans was obtained, 49% within 12 months after TL. For every 1 month after TL, postoperative LM was +0.01-point (p=0.49). Conversely, for every +1-point in preoperative LM, postoperative LM was +1.08-point (p=0.001). Two patients required endoscopic sinus surgery after TL for persistent sinonasal disease.

**Conclusions:** Preoperative sinonasal disease burden likely plays an important role in the development of clinically significant rhinosinusitis in TL patients. Correlating radiographic findings to validated outcome measures remains a critical aspect of determining optimal surgical candidates, this arena is still under investigation in this unique patient cohort.

**Introduction**

Patients who have undergone TL for malignancy of the aerodigestive tract develop an intragoneal interruption of the continuity of the nasopharyngeal airway. Alterations of the intranasal mucosa, mucociliary transport, and nasal cycle have all been described as changes due to absence of nasal airflow. This results in microscopic changes within the human respiratory nasal epithelium as the mucociliary system atrophies and mucus production decreases. Similarly, symptoms such as severe hyposmia has been reported in two-thirds of TL patients, likely secondary to compromised transport of odorant molecules to olfactory mucosa as well as surgical interference with sensory laryngeal nerves which may alter olfactory function through a complex feedback mechanism. In spite of these observed morphological changes, it remains unclear whether TL patients experience clinically significant sinonasal disease.

**Methods and Materials**

A database query was performed on July 25, 2017 to identify 50 patients status post total laryngectomy with and without neck dissection (CPT 31560 and 31805) between January 2002-2018. A separate database query was also performed to concomitantly identify patients who underwent imaging (CPT 70450, 70452, 70460, 70470, 70486-8, 70490-92, 70496, and 78811-6). Parameters analyzed include age, indication for surgery, gender, ethnicity, smoking history, ethyl alcohol consumption, and TMH stage. Co-morbidities enumerated include a prior history of acid reflux, allergic rhinitis, asthma, chemotherapy, chronic obstructive pulmonary disease, chronic rhinosinusitis, and sinus surgery. Imaging findings were tabulated using Lund-Mackay (LM) scores. To analyze the primary outcome of LM scores, a fitted, mixed model approach was applied which includes random intercept and slope effects for each patient.

**Results**

Fifty TL patients (197 LM scores, mean 3.9 CT scans) were included in the analysis. A series of identified rhinologic-associated comorbidities including acid reflux (50%), allergic rhinitis (2%), asthma (8%), and chronic rhinosinusitis (10%) was observed. A modest increase in postoperative LM scores was observed, with a mean and median of 2.7 and 1.0 (range 0-19).

**Trend Analysis: Lund-Mackay Scores**

![Trend Analysis Graph](Image)

The interpretation of the fixed effects of time since surgery and preoperative LM score on postoperative LM scores is for every 1-point increase in preoperative LM score, postoperative LM scores were associated with an increase of 1.08 points (95% CI: 0.73 to 1.42), a significant effect (p<0.001). Please refer to the figure below:

**Radiographic Imaging**

- **Preoperatively (LM=2)**
- **24 Months (LM=6)**
- **42 Months (LM=8)**
- **83 Months (LM=19)**

**Discussion**

Inadequate nasal airflow is purported to be a potential cause of nasal pathology, one would expect sinonasal disease etiologies such as rhinosinusitis to be associated with TL patients. Our study suggests that all of the analyzed patient clinical factors, preoperative sinonasal disease burden plays the largest role in developing radiographically apparent findings over time. As a result, capturing this important clinical parameter will dictate counseling patients on their symptomatology in future follow-up clinic visits as well as assist in the determination of which patients may require operative intervention for refractory nasal symptoms.

**Conclusions**

Preoperative sinonasal disease burden likely plays an important role in the development of clinically significant rhinosinusitis in TL patients. Correlating radiographic findings to validated outcome measures remains a critical aspect of determining the degree of observed symptomatology and the concomitant need for surgical intervention; this arena is still under active investigation in this unique patient cohort.

**References**