

Post-thyroidectomy and Perturbation of Aerodynamic and Acoustic Parameters

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RESEARCH QUESTIONS: The present research aims to analyse postoperative manifestations of partial or total removal of the thyroid gland in terms of their aerodynamic and acoustic consequences. This investigation is a follow-up study of previous work that was presented at ISSP 2007 in Tianjin, with now significantly more data and robust statistical analyses.

Postoperative sequelae may provoke severe destructive consequences in patients that often lead to temporary or permanent dysphonia (Fauth, 2012; Trésallet & Menegaux 2015). Some patients who suffer from thyroidectomy-related dysfunctions may tolerate radio-therapeutic treatment. However, their speech production system could be negatively impacted, resulting generally in degradation of voice quality, or more seriously, in permanent palsy symptoms of the vocal folds (with morbidity ratio less than 5% of cases). In France, about 45,000 thyroidectomy interventions, together with other related surgeries, represent potential risks for laryngeal palsy, per year (Fortuny *et al.*, 2015). Results are globally discussed within the conceptual perturbations and readjustment framework, posting that speech dysfunctions could contribute to understanding normal productions, and also to assessing the degree of flexibility of the speech production system.

METHOD

Corpus: The entire corpus is composed of sustained vowels [i, a, u] and VCV nonsense words. For the nonsense words, the vowel is always [a] and the consonant is one of the 6 plosives [p], [t], [k], [b], [d], [g] and the 6 fricatives [f], [s], [ʃ], [v], [z], [ʒ]. Only results relating to the production of sustained vowels will be presented in this abstract. However, results pertaining to the entire data (Xiu, 2018) will be presented and discussed during the conference.

Subjects: 28 patients participated in this experience: 25 patients without laryngeal mobility failure after surgery were assigned to the “Normal Group” (18 women and 7 men) and 3 patients with laryngeal mobility failure after surgery composed the “Paralysis Group” (1 woman, 2 men). This is a longitudinal study whereby the reference voice is constituted by the speaker’s voice in the preoperative phase.

Data acquisition: Before each recording, the patient had to complete the Voice Handicap Index (VHI) questionnaire (Jacobson *et al.*, 1997). This questionnaire consists of a psychometric assessment in order to measure the disabling psychosocial effects associated with voice disorders. Each of the 3 sustained vowels was produced 5 times. This task was repeated twice in order to allow acquisition, first of aerodynamic data, and then of acoustic data. The data were acquired in a hospital in 4 recording phases using the EVA2 system (Ghio & Teston, 2004): one preoperative phase (Pre-op) and three postoperative phases (PO1-2-3). PO1 corresponds to the day after surgery; PO2 and PO3 are respectively 15 days and 30 days after surgery.

Measurements: We analysed acoustic cues related to potential signal perturbations, *i.e.* Jitter, Shimmer, HNR and F0. Oral Air Flow (OAF), Maximum Phonation Time (MPT) and Intraoral Pressure (IOP for consonants only) were examined for aerodynamic behaviour.

HYPOTHESES: Expecting irregular vocal fold activities after thyroidectomy, the following two major hypotheses were put forward: 1) Among the four acoustic parameters observed in measuring vocal fold perturbation, Jitter and Shimmer values should increase because of perturbations related to surgery. In contrast, due to a possible noise invasion of vowel formant structures, F0 and HNR values should decrease; 2) The three aerodynamic parameters measured would also be perturbed, with a significant increase in oral airflow due to laryngeal dysfunction, and a decrease in maximum phonation time, given probable overconsumption of air caused by attenuation of laryngeal efficiency.

Main Results: Values for the “Paralysis Group” are reported individually because the 3 speakers suffered from different types of laryngeal mobility injury (see Figures II through IV). In contrast,

statistical analyses (one-way ANOVA with repeated measures) were carried out for the group of patients who all suffered from dysphonia, however, without vocal fold paralysis (“Normal Group”).

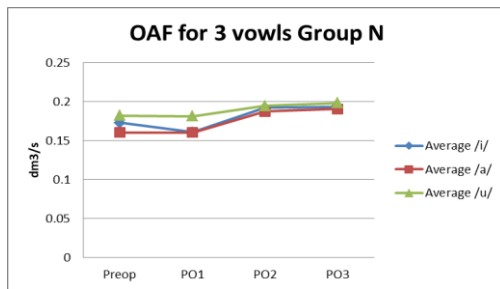


Figure II Figure I OAF for vowels [i, a, u]. Normal subjects

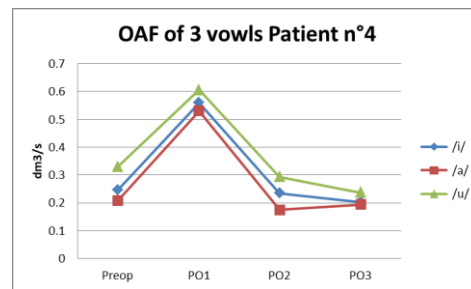


Figure II OAF for vowels [i, a, u]. Patient N°4

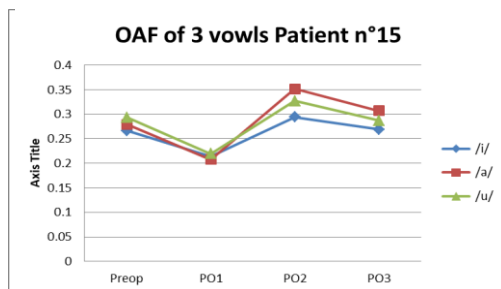


Figure III OAF for vowels [i, a, u]. Patient N°15

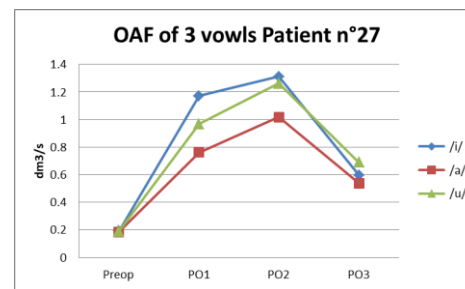


Figure IV OAF for vowels [i, a, u]. Patient N°27

In general, results indicate that removal of the thyroid gland alters the voice of patients even when laryngeal mobility is preserved. All parameters studied were modified. Thus, Jitter and Shimmer increase while HNR and F0 decrease (the latter analysed separately for women and men). Similarly, we observed a significant increase in the values of OAF, given graphically in Figure I for the “Normal Group ($P=0.064 > 0.05$ for vowel /i/; $P=0.03 < 0.05$ for vowel /a/; $P=0.335 > 0.05$ for vowel /u/), and for the 3 patients with vocal fold immobility in Figures II, III and IV). A reduction of MPT after surgery was observed, compared to preoperative values, for the "Paralysis Group" of 3 patients. Time has systematically a positive effect on the parameters of all the speakers, since their productions approach, one month after surgery, values measured in the preoperative reference phase. In general, patients show different compensatory readjustment strategies at the inter-individual level, while at the intra-individual level, the same patient uses more or less the same manoeuvre in producing all three vowels. Perception tests are currently being carried out, and results obtained, coupled with the VHI data (Xiu, 2018), will be reported during the conference.

References:

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