

An acoustic study of plosive consonants produced by patients with reconstruction after partial or total glossectomy

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Surgery of the oral cavity can cause severe impairment of the three basic functions; chewing, swallowing, and articulation of speech. The latter indicates a significant decrease in the patient's quality of life (Savariaux et al., 2001). The recovery process is controlled by the extent of the lesion, the age of the patient and the impact of the surgery on the oral cavity muscles (Buchillard et al., 2007). Patients have to adapt their speech to a spatiotemporal adjustment of their oral cavity.

Partial or total glossectomy with reconstruction produces a serious functional defect of the articulators. The present study considers articulatory analyses of acoustic speech patterns at different postoperative stages, by comparing pathological and normal speech data. This longitudinal study falls within the *perturbation and readjustment paradigm* (Vaxelaire, 2006) preoccupied mainly with evaluating the *flexibility* of speech production, intelligibility and perception system, and determining the range of linguistically tolerated deviations from speech 'targets'.

The eight patients who underwent partial or total removal of the tongue have been recorded in the Otorhinolaryngology services of different hospitals. Various types of surgery were realized according to the localization of the cancerous tumor. Four patients underwent partial glossectomy, one hemiglossectomy and three pelvic glossectomy including a total one.

Data were collected in four phases: 1) a pre-surgery phase, the day before the surgery (reference voice); 2) a first post-surgery phase, 1 month after the surgery; 3) a second post-surgery phase, 2 months after the surgery; 4) a third post-surgery phase, 4 months after the surgery. Data were also gathered from six healthy control speakers, matched with age and gender. Such data served as reference values for disordered pathological subjects.

The selected linguistic material involved ten repetitions of VCV sequences in which the consonant is one of voiceless occlusive / p, t, k /; or voiced: / b, d, g / and where V1 = [i] and V2 = [a] (and conversely). Acoustic signal analysis was based on formant frequencies for vowels, and Voice Onset Time in reference to Klatt (1975) for consonants.

It is hypothesised that in the first post-surgery phase of patients with reconstruction produce a severe structural modification which:

- Disrupts the temporal organisation or acoustic *timing* of signal because of the execution hindered by the articulatory gestures;
- Reshapes the configuration of the cavities of the vocal tract resonances and leads to incongruous and consonant deviant productions;
- Causes after treatment and speech therapy an adjustment in the timing of the signal of word, indicating compensatory strategies used by the patient for the production of suitable sequences.

At the temporal level, the results show timing differences of the VCV sequences between healthy and pathological speakers, in first post-operative phases. These articulatori-acoustic abnormalities tend to be reduced at the late post-operative phases.

The results of our investigation are interpreted in terms of *adjustments* to the new configuration of the vocal tract, the compensation mechanisms in obtaining closer articulatory-acoustic 'targets', and the evolution of productions along a period of six months after surgery and speech therapy rehabilitation.

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