# BOLD-MRI of the parotid glands before and during gustatory stimulation

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## Introduction

Radiotherapy of head and neck cancers often induces xerostomia, a major cause of reduced quality of life for these patients. Recently, new technical advances have been developed to allow the protection of the salivary glands during treatment [1,2], and the function of these glands is usually evaluated using saliva flow measurement techniques or invasive methods such as scintigraphy. The aim of this study was to examine the feasibility of blood oxygenation level-dependent imaging (BOLD-MRI) [3] as a non-invasive technique to assess parotid gland oxygenation during gustatory stimulation.

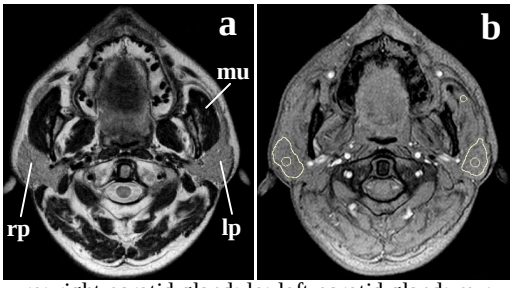
## Methods

Ten healthy volunteers (7 men and 3 women; mean age: 33.7 ± 9.1 years) were included in this study. Measurements were performed on a 1.5T MR scanner (SONATA, Siemens, Germany) using a body coil for transmission and a phased array head coil for reception. Axial turbo spin-echo $T_2$-weighted images were first acquired for morphological evaluation, then a modified Multi Echo Data Image Combination sequence ("MEDIC", TR: 65 ms, TE: 6-52.31ms, flip angle: 30°) was used to acquire 12 $T_2$*-weighted images at the midlevel of the parotid glands, before (5 min) and during (25 min) stimulation with a tablet of Vitamin C (500 mg of ascorbic acid, Redoxon®, Roche, Switzerland). $R_2$* maps were calculated [4]. Regions of interest (ROIs) were selected in left and right parotid glands, as well as in the masseter muscle for comparison (Fig.1). Circular ROIs were first drawn, then "freehand" ROIs including the most part of the gland were delineated, and mean values of $R_2$* indices were determined.
Statistical analysis (SPSS 12.0) was performed using MANOVA with 4 (volunteer, circular/"freehand" ROI, left/right parotid, baseline/stimulation) and 2 (volunteer, baseline/stimulation) factors for the parotid glands and the muscle, respectively. An unpaired Student's t-test was added to confirm the comparison between baseline and stimulation, merging left and right parotid glands.

## Results

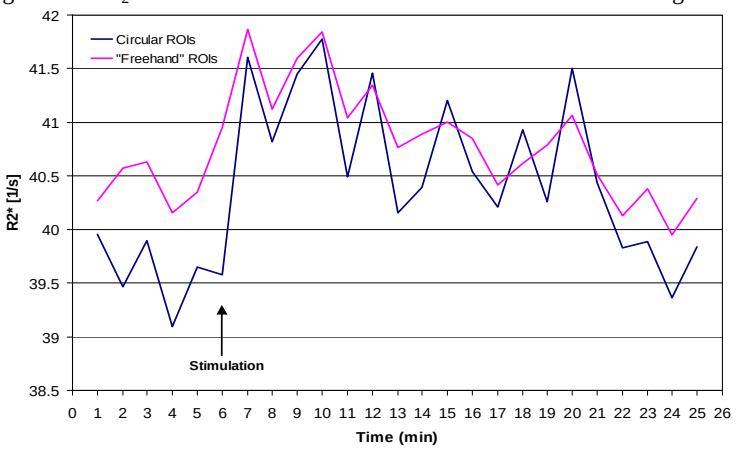
The $T_2$-weighted images did not reveal any abnormality of the parotid glands in any of the volunteers (Fig.1a). No significant differences were observed between left and right parotid gland. A significant ($p = 0.002$) difference was evidenced according to circular or "freehand" ROI selections, with a higher $R_2$* mean value for "freehand" ROIs (Fig.2). In both circular and "freehand" ROIs, $R_2$* mean values were shown to significantly increase ($p < 0.001$ and $p = 0.005$, respectively) during stimulation (Fig.2). The muscle did not reveal any significant difference before and during stimulation. A highly significant inter-individual difference ($p < 0.001$) at rest and during stimulation was evidenced between volunteers for parotid glands as well as for the muscle.

Fig.1: Axial $T_2$ (a) and $T_2$* (b) weighted images at the midlevel of the parotid glands, showing circular and "freehand" ROIs (b)




rp: right parotid gland; lp: left parotid gland; mu: masseter muscle.

Fig.2: Mean $R_2$ values in circular and "freehand" ROIs before and during stimulation




## Discussion/Conclusion

Our results demonstrate that BOLD-MRI is a reliable tool to study oxygenation within the parotid glands. The results evidenced a significant increase in $R_2$* values during stimulation, suggesting an increased perfusion with consequent increase in oxygen consumption during saliva production by the parotid glands. However, the large between- and within-individual variability produced a scattering of the results. In cohorts, BOLD-MRI can be used as a non-invasive method for observing changes in oxygenation of the parotid glands during gustatory stimulation.

### References

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