MR-Elastography of the Parotid Gland

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Introduction

In the general population, salivary gland neoplasms represent less than 3% of all tumors. Within salivary gland tumors pleomorphic adenoma is the most common tumor and represents 70% to 80% of all benign tumors of the major salivary glands. Nevertheless, preoperative differentiation between benign and malignant tumors influences the operative approach and the long-term outcome [1]. Here, Elastography as a non-invasive imaging technique represents a promising candidate, because it has been reported, that experienced ENT surgeons can differentiate tumors by palpation [1]. Dynamic steady-state MR-Elastography has the benefit to provide full 3D information to enable a correct reconstruction of the viscoelastic parameters.

Methods

Five healthy volunteers (mean age, 32 yrs; age range 27 to 38) were examined in supine position with a 3T whole body scanner (3T Intera; Philips Medical Systems, Best, The Netherlands) using a 8-channel SENSE head coil. The mechanical transducer was placed on the left parotid gland pushing in left-right direction at a frequency of 100 Hz (Fig.1). MR-Elastography data's were acquired using a motion sensitized spin echo sequence with EPI readout (TR 301ms, TE 40ms, flip angle 90°, EPI factor 3). Slice orientation was transverse with a FOV of 64mm, 64^2 pixels resolution and a slice-thickness of 2mm. Five adjacent slices were measured. Total scan time for all three spatial displacement directions was about 9 minutes. Reconstruction of shear modulus and shear viscosity is done utilizing the technique described in [3].

Fig.1: Experimental setup with transductor placed right next to the parotid gland (arrow) of the volunteer.

Results

Very good penetration of the mechanical waves throughout the entire parotid gland was observed. Mode-conversion of the longitudinal wave at interfaces leads to shear waves generated everywhere inside the organ (Fig 1b). The amplitude of the penetrated wave close to the transducer was 80 to 100 μm. The mean shear modulus for the whole parotid gland of all five volunteers was 1.29 ± 0.08 kPa. Shear viscosity was calculated with 0.84 ± 0.33 Pa*s.

Discussion

This work demonstrates the technical feasibility of in-vivo parotid gland MR-Elastography. The shear modulus in all volunteers proved to be very homogeneous, whereas the viscosity showed a fairly high standard deviation within the glands. The viscosity is closely related to the water content of tissue. Therefore this phenomenon might be explained with an inhomogeneous status of hydration of the glands. The small standard deviation of the shear modulus of healthy parotid glands indicates that a differentiation of tumorous lesions within the parotid gland should be possible. Measurements to pathology are in progress.

References

[1] Eneroth et. al, Cancer 27, 1415 1418 (1971)

[2] Sinkus et. al. MRI 2004 (in press)

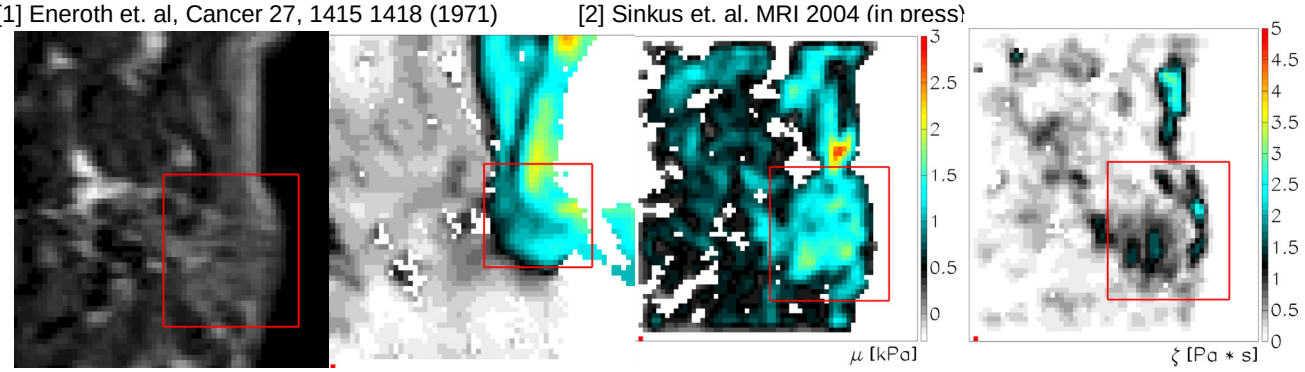

Fig.1: a) Transverse MR-magnitude image of the parotid gland from a healthy volunteer. b) visualization of the mechanic wave. c) reconstructed shear modulus and d) shear viscosity of the salivary gland.