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Introduction

The face expression is animated by the movements of the muscles, which can be altered during pathology. The main objective of this study is to develop an experimental imaging protocol to evaluate the functional properties of the zygomaticus major (ZM) muscle using Magnetic Resonance Imaging (MRI) and ultrasound (US) elastography techniques. In addition, the metabolic behavior of the ZM has been characterized with MR Spectroscopy (MRS).

Methods

Eight healthy volunteers (age range: 21 - 30 years) without face muscle damage have been recruited at Amiens Hospital (France). Three capsules full of oil have been placed in three face area (nose, ear and chin), allowing a tracking accuracy for ultrasound fusion process. Subsequently, each subject has undergone MRI, MRS and US elastography tests. 3D-T1 MRI sequence (Philips®, 3T) has been performed with different coils to localize the ZM and the tracking components. MRS has been applied in the center of the ZM using different TE (35ms, 144ms, 288ms and 432ms). Four spectral profiles showing the ZM metabolic behavior have been recorded. After MRI/MRS acquisitions, B-mode ultrasound (SLH20-6 probe), shear wave elastography (SL10-2 probe) and fusion process have been performed in the same ZM area using an Aixplorer® machine. Morphological parameters, elastic properties and superimposition of the ZM anatomical images (MRI & US) have been determined.

Results

The SLH20-6 probe, clinically used for hand tendon, provides a more accurate definition of the face muscle structure compared to the SL10-2 probe. The mean thickness of the ZM is 1.83 ± 0.28 mm. A better signal to noise has been obtained with the dStream Head 32 channels. The mean elastic properties were 19.60 ± 2.63 kPa. These values are in the same range as other head and neck muscles [1]. The fusion process, clinically used for abdominal tests, has been successfully developed for the face demonstrating an accurate superimposition of MRI and US face tissues. MRS acquisitions have identified well known metabolites usually present in muscle tissue [2].

Discussion

The originality of this study has been to provide new functional, morphological and metabolism properties of the zygomaticus major muscle. The present protocol could be applied to evaluate the effects of treatment (such as injection inside the ZM) on the functional properties. These measurements will help clinician to adapt and follow the treatment. Future MRS measurements will be performed to accurately identify the ZM metabolism behavior which could be correlated to the elastic properties.

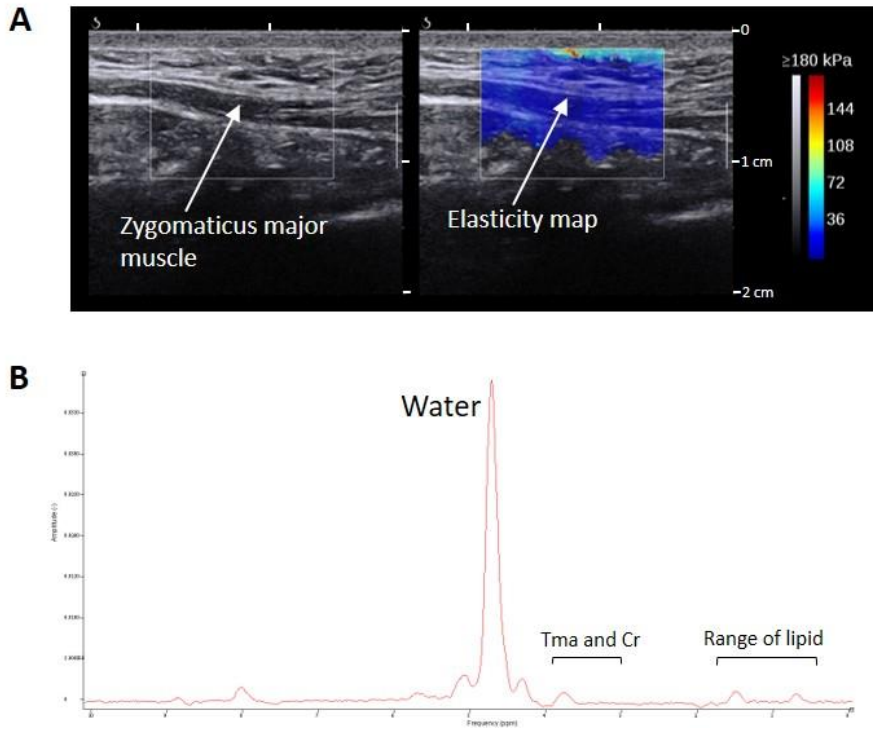

Figure 1: A) elasticity map obtained with ultrasound elastography technique. B) Spectral profile (TE = 144ms) obtained with MRS technique.

Acknowledgements

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References

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[2] Pola et al. 2012. Progress in Nuclear Magnetic Resonance Spectroscopy.