In-vivo Dental Impression Using MRI

O. Tymofiyeva[1], F. Schmid[1], K. Rottner[2], E-J. Richter[2], and P. M. Jakob[1]

[1]Dept. of Experimental Physics 5, University of Wuerzburg, Wuerzburg, Germany, [2]Dept. of Prosthodontics, Dental School, University of Wuerzburg, Wuerzburg, Germany

Introduction: The accuracy of manual dental impressions suffers from the liquids in the mouth of the patient, imperfect coverage of the impression material, deformations during the removal of the material, and therefore it has a very low reproducibility. Studies on the marginal fit of restorations produced by manual impression techniques show that mean errors of 400 μm occur in practice [1]. The MRI-based method of tooth surface visualization [2] provides an alternative technique of taking a dental impression which can be directly used for CAD/CAM production of dental restorations. It is based on obtaining the MR signal from the surrounding medium (e.g. water) in the mouth of the patient and allows to indirectly observe the surface of teeth.

Subjects and Methods: Five healthy volunteers were examined on a 1.5 T whole-body scanner (Siemens Avanto) with a 4 cm diameter surface coil. A 1.5% solution of agar with 0.15% Magnevist (Schering) was used as contrast medium. When the solution had cooled down to 50°C, the volunteer took a sip of it and kept it in his mouth, where it hardened after a few minutes. This allowed to avoid artefacts arising from the motion of the fluid reported before [2] and restricted the uncontrolled motion of the lips and cheeks. The volunteer was positioned prone, so that the liquid could cover the front teeth.
A 3D Turbo Spin Echo sequence with TR/TE = 400 ms/14 ms and turbo factor 5 was used. The field of view was chosen to be $56{\times}31$ mm^2, and slab thickness was 12.4 mm. With a $192{\times}106{\times}40$ matrix, the nominal resolution was $292{\times}292{\times}310$ μm^3. The scan time was 7 min.

Results and Discussion: A picture of one of the volunteers' teeth is shown in Fig. 1. The MR data was segmented and the surface of the teeth was reconstructed using 3D visualization software (Amira) (Fig. 2). The comfortable positioning of the volunteer, the fixation of the vestibular area with agar and a relatively short measurement time restricted his motion. The results presented demonstrate the possibility of using MRI for dental impressions in-vivo. The quality of the impression can be further improved by using dedicated RF coils.
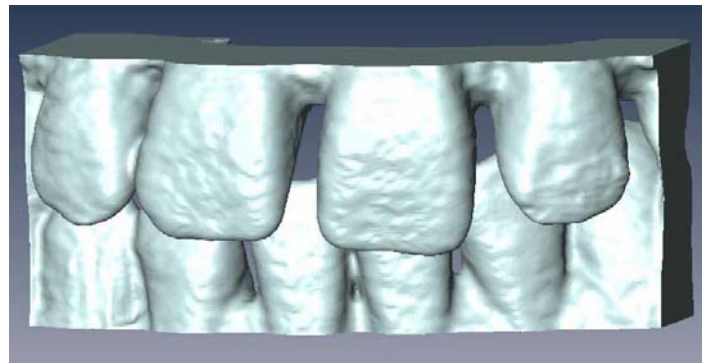

Fig. 1. Photo of the teeth

Fig. 2. Surface reconstruction of the MR data

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