Imaging the Mandibular Nerve at High Isotropic Resolution using a Turbo Spin Echo with Local Look

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Introduction

Precise knowledge of the course of the mandibular nerve is necessary in order to determine correct positioning and size of dental implants. Standard X-ray panoramic imaging suffers from lack of three dimensionality and distortions caused by beam projection. Conebeam computed tomography (CBCT) can provide three dimensional (3D) information, but unfortunately at the cost of a higher radiation exposure. Recent studies have shown that MRI is a promising alternative to CBCT mandibular nerve imaging [1-3]. Standard MR protocol consists of a 3D VIBE sequence with an anisotropic resolution depicting the entire head [3], whereas in most cases the region of interest is restricted to one side of the mandible. In order to shorten imaging time or increase resolution, the FoV can be limited to only the relevant anatomic structures. Here an alternative protocol to the 3D VIBE is presented, which allows high isotropic resolution within the same scan time, using a TSE with Local Look technique [4].

Materials and Methods

To limit the field of view in the phase encoding direction without using spatial saturation or phase oversampling, the Local Look technique was implemented in a turbo spin echo (TSE) sequence for a clinical 1.5T scanner (Magnetom Avanto; Siemens, Erlangen, Germany). The patients head was placed between two four channel multifunctional coils (Noras MRI products, Hoechberg, Germany), which also served as a fixture. The protocol consisted of a 3D TSE with an isotropic resolution of 0.5x0.5x0.5mm³ and TE/TR = 9ms/500ms. Field of view was set to 128x72x22mm³ with phase encoding direction from head to foot. An additional 3D VIBE scan was performed with same field of view and resolution. Spatial saturation was used to limit the field of view in phase encoding direction in this case. Scan time was 6.5min for both sequences.

Results

Figure 1 shows two orthogonal slices from the 3D VIBE sequence (top). The loation of teeth as well as the course of the nerve canal can be identified (arrows), however, signal is quite low. The TSE image (bottom) provides higher contrast between bone marrow and nerve canal. The nerve canal's course can be easily followed in the right image. The right images shows a coronal section, where the mental foramen can be seen. Since voxel size is the same in all three dimensions, oblique reformatting can easily be performed at low resolution-loss. In figure 2, a 3D model of the segmented data can be seen. A part of the mandible and teeth are shown in grey while the nerve canal is shown in red. The position of the roots is clearly visible.

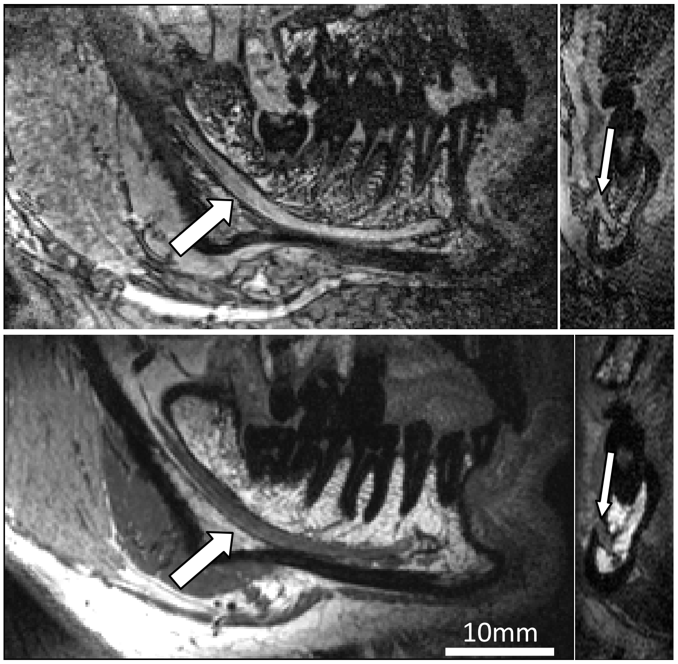

Fig. 1: Orthogonal slices from the 3D VIBE (top) and 3D TSE (bottom) data set. The path of the mandibular nerve canal (big arrow) can be seen in the sagittal plane (left). In the coronoal view (right) the foramen mentale (small arrow) can be seen.

Discussion

The presented protocol allows imaging of the mandibular nerve canal at high isotropic resolution within reasonable scan time. The contrast allows a good differentiation between nerve canal and surrounding bone marrow. All important anatomical details can be identified as seen on the segmented data set. The isotropic resolution allows retrospective oblique slice selection. Since measurement was performed in 3D, easy quantification of distances can be performed. However initial trials with patients still have to be performed.

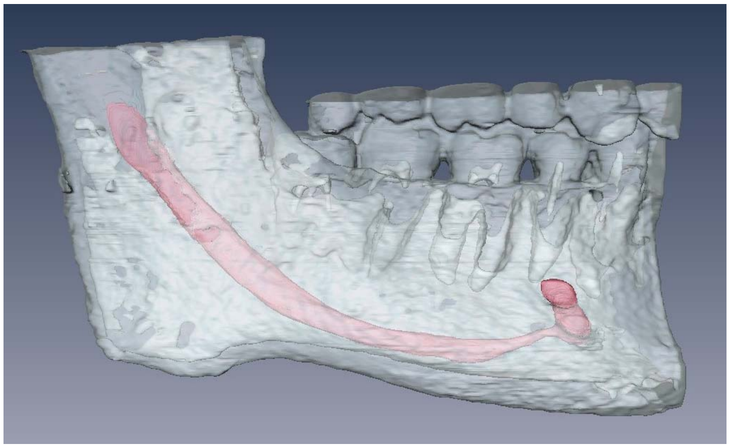

Fig. 2: 3D model from the segmented TSE data set. A part of the mandible is shown in grey and nerve canal in red.

Acknowledgments

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