MRI Examination of the Temporomandibular Joint Using a Microscopy Coil

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Authors: A. Šprláková-Puková, A. Stouracova, M. Keškovský, O. Liberda, O. Smirg; Brno/CZ
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Purpose

The temporomandibular joint is a synovial joint and receives heavy use during a person's life. The joint is made up of the condylar process of the mandible and the mandibular fossa on the temporal bone. The non-bone part of the joint is the disc, a structure composed of cartilaginous tissue and often compared in the literature to a meniscus. The disc divides the joint into two parts, an upper and a lower one. It is located above the condylar process, and it serves for the fluent forward movement of the condyle. The disc is thinner in its center than at either end, and in the cross section in the sagittal plane it has a figure-eight shape. Its posterior portion extends to the retrodiscal tissue, known in the literature as the bilaminar zone (1), which includes a fibrous component.

It is possible to visualize the non-bone structures of the joint using ultrasound and MRI (2). Ultrasound is a simple and generally accessible method, but it bears the familiar limits of subjective assessment. Furthermore, detection of cartilage tissue is limited by age and its changes. Structures deep inside the joint cannot be detected at all with ultrasound.

Magnetic resonance is the only method that proves capable of visualizing joint structures (3). Nevertheless, this method also carries certain limitations given by the technology itself, especially the possibility of using a certain type of coil. To visualize a surface structure, it is ideal to use microscopic coils with a field of view limited to the particular area. Such data collection makes it possible to visualize structures in more detail and with higher definition and greater tissue contrast.

Aim of the work

The aim of this work was to compare selected structures (4) during assessment of the temporomandibular joint by two independent experienced radiologists. Of the two examinations, one was carried out with a microscopy coil and the second with a C3 surface coil.

Selected structures included:

- the hyaline cartilaginous layer that intra-articularly covers the condylar process;
- subchondral changes on the condylar process;
- the articular disc - its contours, precise demarcation and possibility of using a segmenting program for its subsequent modeling;
- the retrodiscal tissue, posterior longitudinal ligament;
- the external acoustic meatus and structure of the inner ear;
- the medial crest of the mandibular condyle;
- change of signal in the bone marrow of the mandible.
Methods and Materials

Examinations were conducted using a Philips Achieva 1.5 T device, with a 47 mm microscopy coil and a PD protocol at three planes, STIR sequence and dynamic bFFE sequence. The examinations at three planes were carried out with a view to subsequent segmentation of the disc and its 3D reconstruction.

A second group of patients was examined with a surface coil using the C3 protocol - PD and T1 FFE with sagittal view, T2 3D FFE coronal view, and bFFE sequence with gradual opening of the mouth (5, 6).

Ten patients were examined with the microscopic coil in total, and their results were compared with a random sample of 10 patients examined with the surface coil. For statistical processing, we had available comparisons of 70 anatomic structures in the two groups.

The assessment was made on a scale of 1 to 4:

1 = reliable assessment, 2 = assessment possible, 3 = assessment difficult, 4 = assessment not possible
Results

In both cases - whether using the microscopy or surface coil - the patient's cooperation is necessary in order to prevent motion artifacts.

In the case of the microscopy coil, precise positioning of the coil on the area of interest, i.e. directly at the center of the temporomandibular joint, was very important. In the interest of preventing involuntary motion artifacts - in particular breathing movements - the coil's power cable was not placed over the patient's thorax but rather was affixed to the table of the device. Patients were instructed before the examination how communication with the laboratory assistant would take place during the examination, with the prohibition of giving spoken answers. Until the last sequence, with the included movement of the jaw, the patient remained in the same position the entire time.

Not only should the resting and the moving position of the disc form a part of the assessment of the temporomandibular joint, but also the connection and breadth of the hyaline cartilage on the condylar process of the mandible and changes in the subchondral and retrodiscal tissue, including the posterior ligament. These structures are far more visible when a microcoil is used, as it visualizes the structures in more detail and makes possible their direct assessment. When a surface coil is used, assessment of the structure's retrodiscal tissue and hyaline cartilage is difficult and often is only possible due to indirect surrounding changes in signal intensity. These conclusions were established from statistical evaluation of the anatomic areas that we designated.

From the statistical analysis one may conclude that in the case of examination using the microscopy coil the median fluctuates near the reliable assessment area. This means that in the samples studied a value of reliable assessment occurs much more often than is the case for examination using a surface coil. The values of the first and third quartiles also demonstrate that distribution of the data is narrower and approaches a value between the categories reliable assessment and assessment possible (in the case of assessment graph 1 (Fig.8) and table 1) and approaches the category reliable assessment (in the case of assessment graph 2 (Fig.9) and table 2).

Of course, there are cases using both examination methods (coils) subject to the criteria of the assessment not possible category. It is evident from the graphs, however, that the number of such cases is only minimal for examinations using the microscopy coil. It thus can be said with certainty that statistical data can be evaluated much better when a microscopy coil is used.
Fig. 1: Figure 1 - Examination using a C3 surface coil, sagittal plane PD; arrow indicates the ventrally dislocated disc.

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**Fig. 2:** Figure 2 - Examination using a C3 surface coil, sagittal plane PD; arrow indicates the bilaminar zone.

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**Fig. 3:** Figure 3 - Examination using a C3 surface coil, T2 3D FFE coronal view.

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**Fig. 4:** Figure 4 - Microscopic coil, aPD sagittal view; arrow A indicates the bilaminar zone, arrow B indicates the disc.

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Fig. 5: Figure 5 - Microscopy coil, coronal plane PD; arrow indicates the ventrally dislocated disc.

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**Fig. 6:** Figure 6 - Microscopy coil, coronal plane PD; arrow indicates the bilaminar zone.

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Fig. 7: Figure 7 - Microscopy coil, transverse plane; arrow indicates the disc.

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Fig. 8: Figure 8 - Graph 1 - reader (radiologist) 1 comparing selected structures in the examinations with C3 coil and microscopy coil.

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Fig. 9: Figure 9 - Graph 2 - reader (radiologist) 2 comparing selected structures in the examinations with C3 coil and microscopy coil.

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Conclusion

We proved statistically significant difference between the examinations using different coils and imaging protocols demonstrating the superior image quality of the examination with microscopy coil. The use of appropriate coils and choice of proper examination protocol have a fundamental influence on assessing the structures of the temporomandibular joint.
References


