The examination of the temporomandibular joint on 1,5T magnetic resonance

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Abstract: The most frequent intraarticular disorder of the temporomandibular joint (TMJ) represents the disorder of the functional relation between the articular disc and mandible condyle, i.e. dislocation of the articular disc. Magnetic resonance (MR) optimally visualizes the soft and hard articular tissues (articular disc, articular socket and condyle of the mandible) and its surroundings. The aim of the study was to evaluate findings of MR investigation of the TMJ. We investigated billateraly 26 patients with TMJ disorders during the years 1996 and 2003. All patients were examined on 1,5 T MR. Joints were studied in T1 and T2 weighted images with closed mouth and during mouth opening in dynamic study. MR verified dysfunction was observed in 48 investigated TMJ (92,3 %), hydrops of the joint was observed in 3 joints (5,8 %), arthrosis of the condylar head in 4 patients (7,6 %). Only four TMJ had normal MR finding (7,6 %). MR represents the best method for studying clinically affected joints, for the evaluation of the morphological state of TMJ and the analysis of the dynamic process during mouth opening. Method is also useful for revealing of a disorder in clinically silent joints. T2 weighted image in TSE mode brought best imaging of the joint. The fat saturation sequence was advantageous mainly in liquid storage (hydrops of the joint, edema in the adjacent bone). The dimensions of the articular cleft and bone components of the joint were well-visualized in T1 weighted images.

Key words: Temporomandibular joint – Magnetic resonance

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Introduction

Incidency of temporomandibular joint disorders (TMJ) have increased worldwide during the last years and the age of the first signs of TMJ disorder has shifted to the younger age groups. In the last decade, almost 65 % of persons between 20 and 50 years were reported to suffer from affection of TMJ [1–4]. The most precise determination of the intraarticular affection is brought by the exact imaging of the soft (the disc) and also the hard tissues (the socket and the condyle of the mandible) [3–11]. Magnetic resonance (MR) was chosen to the detailed investigation of the TMJ. In comparison with computer tomography (CT) or X – ray tomography it does not use ionizing radiation, displays more precise differentiation of soft tissue disorders and also bone marrow changes, it is non invasive, has possibility of direct multiplanar imaging and it is not disturbed by artefacts from the tissue interface as is the conventional CT investigation [5,6,8,11]. Temporomandibular affections can be divided into two basic groups: disorders of dental origin and disorders of masticatory muscles. TMJ disorders are diagnosed in up to 33 % of adult population and they are interdisciplinary treated by dentists, oral surgeons, neurologists, neurosurgeons and rheumatologists. The affection of the functional relation of the articular disc and condyle of the mandible, i.e. dislocation of the articular disc [1] represents the most frequent intraarticular affection of TMJ. Dislocation of the articular head can be further divided to the dislocation with reposition, where the dislocated disc gets into the correct relation with the condyle during mouth opening, and dislocation without reposition, where the articular disc stays permanently dislocated while the mouth is open [1–3,7,12].

In our work we prospectively studied patients with TMJ disorders by 1,5T magnetic resonance.

Patients and methods

We investigated 26 patients with clinical motility disorders of TMJ from stomatologic departments during the years 1996 to 2003. The group consisted of 24 females and 2 males of the age varied between 18 to 67 years, average 35,6 years (Table 1). In all patients both joints were examined (totally 52 joints) by 1,5 T MR, Gyroscan NT Philips. TMJ were studied in T1 weighted images in mode Spin echo (SE), in T2 weighted images in mode Turbo – spin echo (TSE) and Fast – field echo (FFE) in T1 weighted images in head coil during closed mouth and during mouth opening in dynamic study. In 10 patients the examination was

Table 1 – Demographic data of investigated persons

	Number of investigated persons	Age of investigated persons (years)	Females	Males
Group of TMJ	26	18 – 67 average 35.6	24	2

combined with fat saturation in mode TSE (SPIR). In T1 weighted images we used repetition time (TR) 500ms, echo time (TE) 20ms. In T2 weighted images we used TR 4000 – 4200 ms, TE 100 – 120ms. We used matrix 256 x 256.

Results

Distribution of pathologic findings is given in Table 2. Pathological findings were found in 48 examined joints (92,3 %), while in 4 others was MR finding normal (7,6 %). In 41 examined TMJ (78,8 %) a functional disorder in the sense of ventral derangement of the disc was observed, in 23 joints this disorder was accompanied with reposition, 18 cases were without reposition. Arthrosis of the head was observed in 4 patients, hydrops of the joint in 3 patients and the total movement restriction in both joints was found in one patient. From the total number 26 examined individuals 10 had affected both joints, either clinically or on MR (38,5 %). 12 patients had unilateral clinical manifestation, but a disorder of the oposite joint to the clinical affection was observed in MR (46,1 %).

Discussion

During the last 16 years of the TMJ research, various examination methods have developed. Arthrography of TMJ, i. e. classical X-ray contrast examination which complementary X-ray analysis by detailed imaging of joint cleft and arthroscopy with direct imaging of the inner part of the joint [13] has used in this diagnosis since 1970s. Computer tomography started to be used between 1970s and 1980s with thin virtual slices in both coronal and sagittal planes with closed mouth. This method proved its validity mainly in patients with congenital and traumatic abnormalities [2,4–6,10,13]. Magnetic resonance (MR), which is using dynamic slices with closed and open mouth has been applied in TMJ diagnostics since eightees [5,6,11–14]. MR appears to be the most favourable method from all these examination procedures because it optimally visualizes the soft tissues of the joint and its surroundings and gives information about the hydratation and morphology of the disc [7,10,11,15–21]. Arthrography and arthroscopy remain

Table 2 – Pathological MR findings in investigated patients with clinical disorder of TMJ

	Number of investigated joints	% of occurrence
Normal MR finding	4	7.6
Ventral derrangement with reduction	23	4.2
Ventral derrangement without reduction	18	4.6
Ventral derrangement as total	41	78.8
Hydrops of the joint	3	5.8
Other findings (restriction of movement, arthrosis)	4	7.6
Pathological findings totally	48	92.3

the complementary methods only in cases of intracapsular adhesions and perforations of articular capsule [14], where MR fails.

TMJ combines function of two joints: During mouth opening the condyle of the mandible rotates in the lower joint and the biconcave disc shifts forward creating the gliding surface to the mandibular condyle. After the condyle apex reaches the transition zone of the disc the joint further scrolls by translation of the upper joint forward under the protection of lateral pterygoid muscle. During maximum mouth opening the condyle reaches the apex of the articular process. The disc covers the condyle in this position from above. Its transition zone is located between the articular process and ventral surface of the condyle. In closed mouth the condyle is located in articular socket between the ventral edge of the condyle and articular socket. The most common affection in TMJ region represents the ventral derangement of the disc, which can be partial or complete, i.e. grade I and II. Their differentiation can be carried out during examination with closed mouth. In complete disc derangement the reduction of the disc is often present [4,12,18]. Such reduction is absent in cases of flaccid and relaxed ligament joint structures or in mechanic disorder of the disc [2,4]. In long lasting disorders of disc without the reduction, restriction of mouth opening improves with time due to the increased tension of the dorsal discal attachment, thouth it cannot spontaneously fully normalize. In our cohort of patients we observed 92,3 % of pathological findings, the ventral derrangement of the disc was present more frequently, it occurred in 78,8 % of examined joints. We did not observe any other type of discal derangement in our patients (ventromedial, ventrolateral, medial,

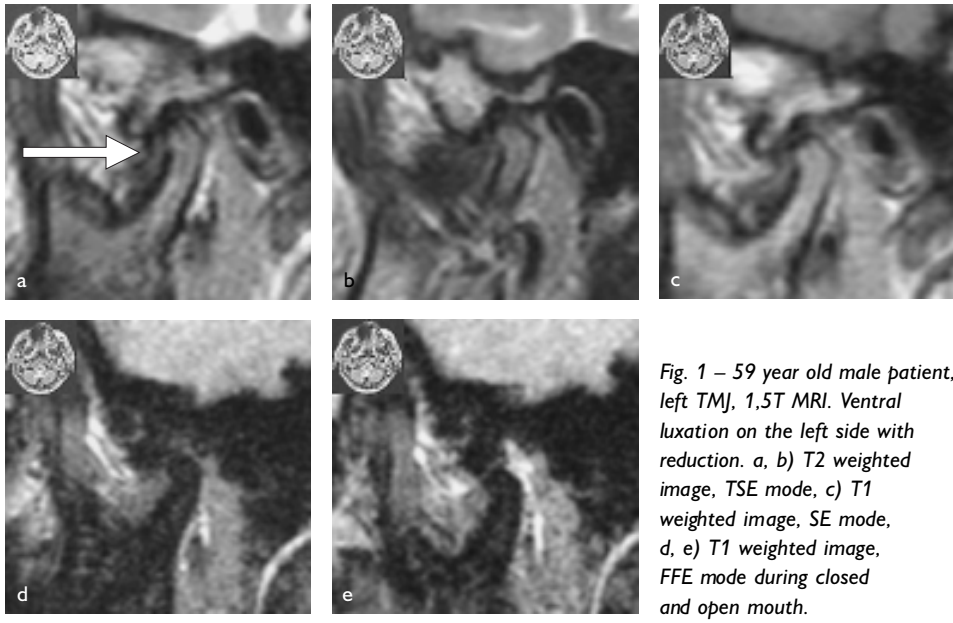

Fig. 1 – 59 year old male patient, left TMJ, 1,5T MRI. Ventral luxation on the left side with reduction. a, b) T2 weighted image, TSE mode, c) T1 weighted image, SE mode, d, e) T1 weighted image, FFE mode during closed and open mouth.

lateral or dorsal). From other less frequent pathological changes we observed the hydrops of joint in synovialitis in 5,8 % and osteoarthrosis in 7,6 % of joints.

Some authors recommend using a surface coil with a small diameter (5 – 12cm) in TMJ examination. We proved simultaneous study of both TMJ in one patient in head coil, which brought good space resolution and favourable signal to noise ratio [2,4,18]. The whole analysis lasted 30 minutes. Transversal slices are used to the localization of the mandibular process and condyle, the state of the periarticular muscles and bony components might be evaluated from them. Oblique sagittal slices, which are parallel to the ascending mandibular crus are used in the inner investigation of TMJ. In T1 weighted images hyposignal cortical bone and hyposignal connective cartilagineous surface of condyle and acetabular fossa are depicted favourably, joint cleft width and bony elements of joint are visualized exactly. Standard T2 weighted images in TSE mode proved as the most favourable sequence in our investigated joint, which corresponds with previous publications [1,2,4,7,11,12,17]. The inner disc, its localization, ligaments, the contents of the joint cleft, and the medulla of the adjacent bony joint parts depicted well. Fat saturation brought further improvement of examined soft tissues joint parts, mainly in liquid storage (hydrops of the joint, edema in the bone), but it significantly prolonged time of MR examination, which is not very good in the daily routine. Patients with TMJ affections cannot stand long investigation in particular if full mouth opening is required and therefore we consider short quick sequences (FFE) to be more advantageous.

Some TMJ affections can be asymptomatic with pathological finding in MR [18], which in our studied group was found also at the opposite side in 46,1 %.

The affection of the head of condyle is described in destructive bony processes, pyogenic artritis, the rheumatic artritis, osteoartritis, cysts (odontoid cysts) and benign (osteomas, ameloblastomas) or malignant tumors (sarcomas, lymphomas, metastases) [1–4,20]. We observed these changes in our patients only rarely; one patient had osteoarthrosis of the joint. Hydrops of the joint was observed in association with synovialitis without proliferation of the synovia.

The derangement of the disc from the normal positition is the important predisposing factor for the development of the degenerative changes in TMJ with continuous progressive discoligamentous changes, finally leading to irreversible bone changes [1–4,11]. From that point of view, MR examination is indicated since early stages of clinically evident TMJ affections. The examination using head coil might disclose the affection of the opposite joint, which is clinically silent.

Conclusions

MR examination represents the most sensitive method for identification of TMJ intraarticular changes. The best visualization of the structure of the joint could be obtained by T2 weighted images in TSE mode. The use of head coil is an advantage, which enables to examine both joints in one individual [21].

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