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Clinical experience

Radiological characteristics of osteoarthritis of temporomandibular joint without disc displacement

TOMISLAV BADEL[1]
MILJENKO MAROTTI[2]
SONJA KRALJEVIĆ ŠIMUNKOVIĆ[1]
JADRANKA KEROS[3]
JOSIPA KERN[4]
IVAN KROLO[2]

[1]Department of Prosthodontics,
School of Dental Medicine
University of Zagreb, Gundulićeva 5
10000 Zagreb, Croatia

[2]Department of Diagnostic and
Interventional Radiology
Clinical Hospital »Sestre milosrdnice«
University of Zagreb, Vinogradska cesta 29
10000 Zagreb, Croatia

[3]Department of Dental Anthropology
School of Dental Medicine
University of Zagreb, Gundulićeva 5
10000 Zagreb, Croatia

[4]Department of Medical Statistics,
Epidemiology and Medical Informatics
School of Public Health »Andrija Štampar«
School of Medicine
University of Zagreb
Rockefellerova 4, 10000 Zagreb, Croatia

Correspondence:
Tomislav Badel
Department of Prosthodontics
School of Dental Medicine
University of Zagreb, Gundulićeva 5
10000 Zagreb, Croatia
E-mail: badel@sfzg.hr

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Abstract

Background and Purpose: *Radiological findings were compared between the patients with osteoarthritis (OA) of temporomandibular joint (TMJ) and asymptomatic volunteers.*

Materials and Methods: *OA was diagnosed in 16 patients (mean age 46.9, 69% women) with disc displacement. A second group consisted of 20 selected dental school students without any clinical signs or history of temporomandibular joint disorders. The inclusion criteria for patients comprised pain referred to the TMJ and/or crepitation. Magnetic resonance imaging was used in this study for all subjects.*

Results: *There is no statistical difference between degenerative changes of the condyle of TMJs with and without clinical signs of OA ($p>0.05$). In 30% of osteoarthritic joints, flattening of condylar joint surfaces was observed and 58.3% of the joints were without clinical signs of OA. Sclerosis of the condyle was found in 30% of the joints and osteophyte formation in 15% of joints with OA. Moderate shape loss and severe sclerosation of the articular eminence were observed in two students in TMJs bilaterally – there is no difference between patients' TMJs with and without OA ($p>0.05$). Pronounced shape loss and severe sclerosation of the articular eminence were found in 10 (50%) joints with OA.*

Conclusions: *Scleroses of the condyle and osteophyte formation were the most common imaging findings of TMJs with OA. However, in asymptomatic volunteers only minimal bone changes were considered normal.*

INTRODUCTION

Musculoskeletal disorders in the area of stomatognathic system comprise the articular and/or muscular component of temporomandibular disorders (TMDs). Temporomandibular joint (TMJ) disorders include disorders of articular disc – disc displacement (DD), and as second, degenerative bone changes or osteoarthritis (OA). Both of these conditions are represented with pathological noises in the TMJ and pain-

Abbreviations:
CT – computerized tomography
DD – disc displacement
MRI – magnetic resonance imaging
OA – osteoarthritis
TMD – temporomandibular disorder
TMJ – temporomandibular joint

TABLE 1

Distribution of osteoarthritic condylar changes of the patients' TMJs (n, number of joints; OA – osteoarthitis; TMJ – temporomandibular joint).

TMJs (n, %)	No sclerosation	Flattening	Severe sclerosation	Osteophytes	Total
with OA	6 (30%)	6 (30%)	5 (5%)	3 (15%)	20
without OA	5 (41.7%)	7 (58.3%)			12
total	11 (34.4%)	13 (40.6%)	5 (15.6%)	3 (9.4%)	32
Fisher's exact test p=0.0982					

ful TMJ with loss of function. Limited mouth opening is also a very important clinical sign of TMDs (*1, 2*).

OA includes a low-inflammatory condition with multifactorial etiology and various radiological pictures, which is similar to osteoarthritic conditions in other synovial joints in the body. Degenerative bone changes include various changes in soft and hard tissues of TMJ. There are more stages of development of OA, which are characterized by structural bone change of the contours of the articular surfaces in various stages (moderate shape loss, severe sclerosation). After the initial stages with pronounced sclerosed areas and shape loss with outgrowths of osteophytes, development of subchondral pseudocyst is also significantly more frequent in the TMJs with OA (*3, 4*).

Radiological examination, including magnetic resonance imaging (MRI), is the most available method of evaluation of osteoarthritic changes and possible interaction with pathological status of the disc (DD) (*1, 5*). There is a controversial relationship between pathogenesis of OA and DD. Some studies showed that TMJs are affected with OA and DD simultaneously (*6, 7, 8, 9, 10*), or OA is present in joints with physiological disc position *(11)*, or joint effusion (*12*). Remodelling of TMJ associated with normal adaptation is discussed in the case of asymptomatic TMJs (*13, 14, 15, 16*), because TMJ pain is very often not related with MRI findings (*8, 9, 12*).

The aim of the present study was to compare clinical and radiological findings between the patients with OA of TMJ and asymptomatic volunteers, both groups with no DD.

MATERIAL AND METHODS

The study group comprised 16 patients with OA of TMJ (mean age 46.9, 69% women) who were selected from a group of 92 examined TMDs patients between 2001 and 2006 using Research Diagnostic Criteria of TMD (Axis I) and manual functional analyses (*17, 18*). The inclusion criteria for patients comprised two conditions: pain referred to the TMJ and crepitation in the TMJ. A second group consisted of 20 selected dental school students (mean age 23.5, 70% women) without any clinical signs or history of TMD (*19*). MRI and panoramic imaging were used in this study for all subjects. Computerized tomography (CT) and conventional radiography of TMJ were also used on 25% of the patients. Active mouth opening was measured by a clipper in millimetres as interincisal distance plus overjet.

The MRI - diagnostics was performed using a magnet on a »Harmony« (Siemens, Erlangen, Germany), at magnetic field magnitude of 1T using a coil for the head. The imaging sequences included the T1 weighted image (TR 450/TE 12; matrix 256× 192; 160× 160 field of view). The seven slices of images were obtained with a 3mm thickness in size. Simultaneously bilateral MR images of the TMJs were obtained on the individually established coronal and parasagittal planes of the images on the basis of a previously performed axial scout. The scans were interpreted using the criteria for OA diagnosis (*18, 19*). The analysis of all scans was performed on every selected parasagittal slice of joint; with presence or absence of the following degenerative bone changes: flattening and sclerosis of joint surfaces, osteophyte formation and subchondral pseudocyst. Disc position was also considered – DD with or without OA was the excluding criteria in this study.

The statistical data analysis was performed by means of the STATISTICA and SAS programmes. The left and the right TMJs of each person were presented as two separate entities within the data analysis. Data were analyzed by t-test or Fischer's exact test. The reliability of MRI assessment was tested for all subjects on the basis of two researchers' (a radiologist's and a dentist's) inspection, which was conducted independently of each other and of the patient's clinical signs in TMJs, and it was evaluated by Cohen kappa index (κ=0,80-1.0)

RESULTS

OA was diagnosed in 20 (62.5%) of all TMJs, in 4 (25%) of the patients bilaterally (20 TMJs with and 12 TMJs without diagnosis of OA). Clinical diagnostics and MRI findings of OA were matching in 12 (75%) patients. The most frequent symptoms reported by the patients were pain (95%) and crepitation (80%) in TMJ. There was a significant difference between active opening of patients (average 42.9 mm) and students (average 52.1 mm) (t-test with p=0.0105).

There were no degenerative changes of the condyle in TMJs of dental students. There is also no statistical difference between degenerative changes of the condyle of TMJs with and without clinical signs of OA (Table 1; Fischer's exact test, p>0.05). In 30% of osteoarthritic joints, flattening of condylar joint surfaces was observed (Figure 1) and 58.3% of the joints were without clinical signs of OA. Sclerosis of the condyle was found in 5% of the joints and osteophyte formation in 15% of joints with OA (Figure 2).

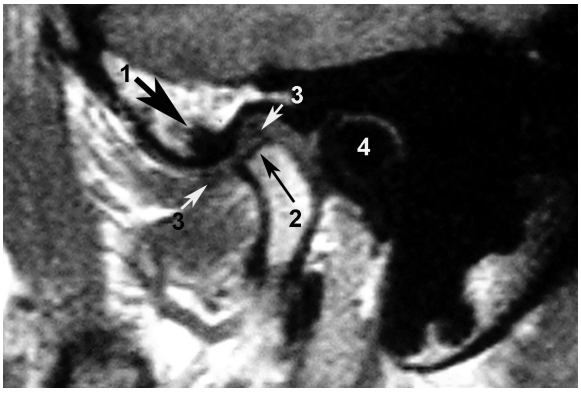

Figure 1. *T1 weighted image MRI of the TMJ in a 39-year-old male person: severe sclerosation in the articular eminence (1), deplaned condyle (2), physiological position of the disc (3), and external auditory meatus (4).*

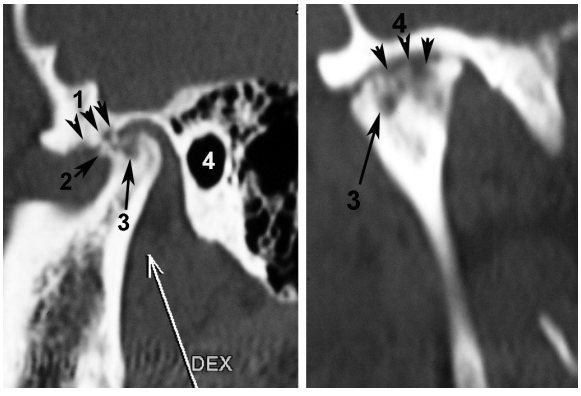

Figure 2. *Computerized tomograms of the TMJ in a 65-year-old female patient (parasagittal (a) and coronal (b) section): severe sclerosation in the articular eminence (1), osteophyte formation (2), osteoarthritic cyst (3), external auditory meatus (4), and severe sclerosation of the condylar surfaces.*

Moderate shape loss and severe sclerosation of the articular eminence were observed in two students in TMJs bilaterally – there is no difference between patients' TMJs with and without OA (Table 2; Fischer's exact test, $p>0.05$). Pronounced shape loss and severe sclerosation of the articular eminence were found in 10 (50%) joints with OA (Figure 1). 95% of osteoarthritic joints showed mild sclerosis of a part or of all articular eminence and 75% of the patients' joints were without symptoms. In one patient's joint with OA the cyst in the condylar head was found only. However, there is obviously a statistically significant difference between the sample of all patients' TMJs compared with TMJs of asymptomatic dental students (Table 2).

DISCUSSION

In this sample of patients with osteoarthritis, a gender-related difference is confirmed, which is characteristic for other subgroups of TMD and similar to those in other joints (*2, 4*).

MRI is widely used in diagnostics of TMJ disorders, because the most prominent clinical sign and symptom pain is connected with both pathological articular conditions – DD and OA. MRI is an appropriate tool for describing changes in cartilage tissues and concomitant soft-tissue alterations. T1-weighted image is recommended for anatomic view of all parts of joints, including hard tissues, and it is used for the analysis of all joints in this study. There is a limitation in interpretation of structural bone changes in the MRI examination – for qualitative osseous tissues imaging the gold standard is CT (*1*).

Martínez-Blanco *et al.* (*7*) found more frequency of crepitation (up to 93.8% in the right TMJs) by joint auscultation. Crepitation is one of the relevant clinical symptoms of OA, in our study it was reported in 80% of patients' joints by manual functional analysis (*18*). In the study of Campos *et al*. (*9*), it was shown that all patients reported TMJ pain, mainly (52% of patients) unilaterally. This study confirmed that joint pain and discomfort is the most important clinical symptom because patients need professional management.

The relationship between joint pain caused by OA and other clinical symptoms is very important, because there is a lack of specific clinical and imaging criteria for diagnosing OA. Radiographic findings of TMJ are useless without before definite clinical decision criteria (*3*). Unknown unique etiology model of OA and many possible etiological factors create a limitation in radiological analysis, including MRI, of the onset and progression of degenerative changes of TMJ- surfaces (*5, 6, 13*). A possible overloading and affecting by multiple biomechanical factors and physiological process of modelling under functional loading make accepted the understanding that joint flattening and

TABLE 2

Distribution of osteoarthritic changes of articular eminence in the subgroups of patients' and students' TMJs (n, number of joints; OA - osteoarthritis; TMJ - temporomandibular joint).

TMJs (n, %)	No sclerosation	Mild sclerosation	Severe sclerosation	Total
patients with OA	1 (5%)	9 (45%)	10 (50%)	20
patients without OA	3 (25%)	6 (50%)	3 (25%)	12
total	4 (12.5%)	15 (46.9%)	13 (40.6%)	32
Fisher's exact test $p=0.1862$				
students	24 (60%)	12 (30%)	4 (10%)	40
Fisher's exact test $p=7.421\times10^{-5}$				

minimal subchondral degeneration could be explained as normal. In this study, it is shown that there is no statistically significant difference between changes of articular eminence between patients' and nonpatients' joints. In the case of mild degenerative changes it is most important to consider the clinical condition in the validation of these radiological signs (*20*). Brooks *et al.* (*16*) and Wiberg and Wänman (*14*) found high prevalence of radiographic sings of OA in asymptomatic TMJs in the case of 50 to 90%. In the validation of MRI finding of OA it is possible to explain mild degenerative bone changes as false positive results (*21*). However, there is some limitation in using various radiological techniques – moreover invasive and/or x-ray techniques are unacceptable for non-patients subjects.

Epidemiological study by MRI on the basis of several good definite criteria of function disturbances addressed to TMJs showed OA changes in 25% of all subjects, unilaterally or bilaterally. MRI is useful in diagnostics of OA in patients with pain during palpation of the TMJs and at limitation of mouth opening less than 40mm (*8*). The population of subjects with clinical signs of OA is not well investigated, and with no request for TMD treatment. There are different subgroups of non-patients population, in our study patients' findings were compared with well selected students' group without any TMD clinical signs of symptoms.

This study includes OA of TMJs with physiological position of articular disc. Many studies using MRI showed that there was strong a connection between anterior DD and development of, potentially secondary, OA (*8, 9*, *22*). Campos *et al.* (*9*) reported that flattening of the condyle is not related to degenerative bone changes, however in their study osteophytes had 40%; and 36% of all joints sample did not have degenerative bone changes. Subchondral cyst was appearing in only 0.5% of all joints. Independent of DD, condylar bone changes were associated with painful joint. However, MRI diagnosis of DD without reduction is significantly associated with joint pain in the case of absence of degenerative condylar changes.

The question is whether to determinate osteoarthritic bone changes as physiological age-related changes, or it is necessary to involve active treatment of clinical and radiological signs of joint tissue impairment. Honda *et al* (*10*) divided degenerative bone changes as pathological or adaptive, and it is shown that pathological changes produced sound with higher energy levels. It has been shown that older patients have OA, especially at the age over 40 (*14*). The findings of several autopsy studies suggested that only 4% of the joints of subjects under 40 present signs of OA (*15*).

In conclusion, the most common imaging findings of osteoarthritic TMJs were sclerosis of the condyle and osteophyte formation. In healthy control group only minimal deplaned condyle and/or articular eminence was found, which was considered physiological.

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