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Tomislav Badel[1], **Sonja Kraljević Šimunković**[1], **Miljenko Marotti**[2], **Sandra Kocijan Lovko**[3], **Josipa Kern**[4] and **Ivan Krolo**[2]

[1]Department of Prosthodontics, School of Dental Medicine, University of Zagreb, Zagreb, Croatia; [2]Department of diagnostic and interventional Radiology, University Hospital ''Sestre milosrdnice'', University of Zagreb, Zagreb, Croatia; [3]Department of Outpatient, General Hospital ''Zabok'', Zabok, Croatia; [4]Department of Medical Statistics, Epidemiology and Medical Informatics, School of Public Health ''Andrija Štampar'', School of Medicine, University of Zagreb, Zagreb, Croatia

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Objectives: To compare characteristics in older patients in a sample of the general population of those with temporomandibular joint disorder (TMJD).

Materials and methods: A prospective study was carried out between 2001 and 2008 in patients with TMJD. The whole sample consisted of 141 patients divided in two groups: 31 patients aged over 60 (median age 67.9, ranging from 60 to 82) and the remaining 110 patients (median age 36.3, ranging from 12 to 59) who were seeking treatment. Clinical diagnostics was confirmed by MRI. Pain intensity was rated on a visual analogue scale (VAS 0-10).

Results: There was no statistical difference between average pain in older patients (6.2) and patients aged up to 59 (5.7) evaluated by VAS. There was a statistically significant difference ($p = 0.002$) in pain duration: older patients reported shorter duration of experienced pain (7.8 months) than patients aged up to 59 (12.2 months).

Conclusion: In this study, it was found that 22% were older patients with TMJD. A higher level of anxiety was shown in both patients' groups, regardless of shorter pain experience in the older patients.

Keywords: temporomandibular joint disorder, magnetic resonance imaging, elderly, anxiety.

Introduction

Temporomandibular disorder (TMD) designates a cluster of descriptive diagnoses of the temporomandibular joint disorder (TMJD) or masticatory muscle disorder, both from the musculoskeletal disorders group[1,2]. The prevalence rate of TMJD increases during adolescence; however, there is no increase in rate in the elderly population. With respect to gender, TMJD is more prevalent in women than men[3–5].

Pain is the predominant symptom for which patients seek help in the treatment of TMJD. Other symptoms are usually differentiated depending on the patient's age; crepitations as well as osteoarthritis are more common in older patients[3,6–8]. Otalgia can also be an indicator if there are no appropriate otoscopic findings[9].

Some studies on TMJD were focused on older patients, or older patients including the elderly were a part of general examined patients with TMJD[4,7,10–12]. The impact of TMJ pain on psychological status of the patient could be related to progression of acute to chronic pain. They have limited everyday oral function, thus allowing pain to have effects on the comorbidity with anxiety, depression etc[13–15].

There is the question whether bruxism is related to TMJD or they might coexist without there being a causal relationship. Tooth wear and bruxist behaviour are permanent problems of the dentition, especially in modern man encompassing almost all age groups[16]. Tooth wear is commonly considered to be a proxy of bruxism. However, tooth wear should be carefully interpreted as a part of bruxist clinical picture[17]. Aetiology of bruxism is

still unclear, but dental factors are not closely involved with the aetiopathogenesis of bruxism[18–25].

Anxiety is the most common affective disorder and a great problem for gerodontology and TMD specialists. In our study, elderly patients had a predominantly higher anxiety level, and in this specific age population, other medical and psychological comorbidities should be considered with musculoskeletal TMJ pain. Regarding the important role of psychological factors in the development of temporomandibular pain, biaxial diagnosis system is necessary in TMJ diagnostics[13,26].

Magnetic resonance imaging (MRI) was accepted as the gold standard for determining the relationship between pain and articular abnormalities in TMJ with respect to the status of articular disc, with well-detectable osseous part of intra-articular structures[27]. The aim of this MRI-based study was to compare clinical and psychological characteristics of older patients in the sample of general population of patients with TMJD.

Materials and methods

A prospective study was carried out between January 2001 and December 2008, and it included 141 patients (82.98% of them women) with TMJ disorder. The whole sample of patients was divided into two groups: 31 patients aged 60 ≥ (median age 67.94 ± 6.55, ranging from 60 to 82, 9.68% of them men) and the remaining 110 patients aged ≤59 (median age 33.75 ± 13.51, ranging from 12 to 59, 19.9% of them men) who were seeking treatment at the Department of Prosthodontics. As the patients were collected consecutively, there was no similarity in the gender ratio. The origins of the patients were 103 (73%) urban, 89 (63.1%) from the city of Zagreb, 53 (37.6%) employed, 4 (2.8%) unemployed, 38 during education (27%), and 46 (32.6%) retired. In the patients aged 60≥, there were 18 (56.1%) from the city of Zagreb, 25 (80.7%) of urban origin and 29 (93.6%) retired. There were no institutionalised persons. All patients were informed of the type and purpose of diagnostic procedures and gave their written consent for participation, and the execution of the study was approved by the Ethics Committee of the School of Dental Medicine in Zagreb.

Clinical diagnostics

Diagnostics was based on the patient's medical history data as well as on clinical examination, and it was confirmed by MRI of all patients' TMJs. The inclusion criteria for patients comprised the following two conditions: pain referred to the TMJ and clicking or crepitation in TMJs with the use of Research Diagnostic Criteria for TMD Axis I (physical examination) and manual examination techniques by Bumann and Groot Landeweer[28,29]. TMJ pain intensity was rated on a visual analogue scale (VAS 0-10)[30].

Clinical examination included a direct analysis of dental status simultaneously. The sum of lost teeth and/or posterior upper and lower teeth that were replaced by prosthetic appliance (premolars and molars apart from the third molars) was particularly noted. Prosthetic appliances, if there were any, were included into dental status, for each jaw accordingly: minor fixed prosthetic appliance (in one quadrant), major fixed prosthetic appliance (in two quadrants of teeth alignment), partial denture, a combination of fixed prosthetic appliance and partial denture as well as complete denture.

Active mouth opening of all patients was measured using a vernier calliper. Before the measurement started, the median point of the maxillary dental arch was marked as well as the occlusal edges of the maxillary teeth on the labial surface of the mandibular central incisor.

For identifying and assessing bruxism, a personal interview and mouth and custom examination were used. The following items were included in the questionnaire for detecting bruxism[31]: When you wake up, do you have jaw fatigue or pain in muscles? Do you grind your teeth or have jaw muscles fatigue when you wake up during night? Has your partner noticed that you are grinding or clenching your teeth during sleep? Have you ever noticed that you were grinding your teeth in the daytime? Are you aware of your excessive teeth wear? Clinical signs of bruxism include interpretation of tooth wear and/or tooth or restoration fracture/failure. Other factors of tooth wear were considered, for example, iatrogenic (ceramic restorations of opposite natural teeth), dental erosions and physiological attrition (facets of demastication) of natural or prosthetic replacement teeth (acrylic teeth in removable dentures).

The degree of tooth wear was classified according to the following criteria[32]: degree 0 is without visible attrition, degree 1 is minimal (physiological) attrition of incisal edges and/or eminences in occlusal surfaces but only on the enamel, degree 2 is the presence of facets parallel with parts of the crown with preserved contours, degree 3 is noticeable wear of incisal edges and/or eminences in the enamel, degree 4 is complete loss of the morphology of incisal edges and/or occlusal planes and in the dentine up to half the height of the

physiological crown of the tooth, while degree 5 is complete loss of physiological morphology of the crown for more than half of it and exposed dentine.

MRI diagnostics

In all subjects, TMJD was determined by MRI (magnetron ''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. The physiological position of the disc is determined according to the intermedial zone position within the shortest span of the osseous contours of the ventrocranial part of the condyle and the articular eminence. The pars posterior of the disc was located on the condylar head. Disc displacement was determined on the basis of the findings of the three representative slices of images in the parasagittal plane[33].

Anxiety measure

The biopsycho-social conceptualisation of the pain experience recognises psychological factors as a part of multidimensional description of pain, especially chronic pain conditions such as TMJD[13]. The psychological assessment was carried out by Spielberger's State-Trait Anxiety Inventory (STAI) Form Y[34]. STAI is the definitive instrument for measuring anxiety and contains four-point Likert items for self-report measure. The range of scores is 20–80, the higher the score indicating greater anxiety. STAI 1 test measures anxiety as a subjective state, a feeling lasting for a week, including the day of testing, and STAI test 2 measures anxiety as a relatively stable individual characteristic during life in general. According to Spielberger, those are three groups of subjects aged: ≤39, 40-49 and 50≥ with different borderline values for different sex. For male subjects, borderline values according to the age groups are 36.54/35.88/34.51 for STAI 1 and 35.55/35.06/33.86 for STAI 2. For female subjects, borderline values according to the age groups are 36.17/36.03/32.20 for STAI 1 and 36.15/35.03/31.79 for STAI 2.

Statistical Analyses

Statistical analysis was performed using Statistica (StatSoft, Inc. 2010. STATISTICA – data analysis software system, version 9.1. http://www.stat-soft.com). The following variables and statistical testing were used: TMJ pain, clicking, crepitation, limiting mouth opening TMJ pain duration in months, pain during rest or pain occasionally, otalgia, degree of tooth wear, active mouth opening, number of lost and non-replacement teeth, pain intensity on VAS, level of anxiety (scale STAI 1 and STAI 2). Fisher's exact test and chi-square test were applied for testing of association of qualitative variables, and Student's *t*-test for comparison of quantitative variables between the two groups of patients (patients aged up to 59 and older patients aged 60≥).

The reliability of MRI assessment (disc position, osteoarthritic changes) was tested for 20 patients' images on the basis of two researchers' (a radiologist's and a dentist's) inspections, which were conducted independently of each other and of the patient's clinical signs in TMJs. They were evaluated by Cohen kappa index ($\kappa = 0.80$–1.0). The frequency of analysed variables was shown in tables with expressed minimal and maximal values, mean value and standard deviation.

Results

There were no statistically significant differences in patients' ratings of the main symptom (TMJ pain, clicking, crepitation, limiting mouth opening) for which they had sought dental assistance (Fisher's exact test, $p = 0.436$) (Table 1). Pain in the TMJ is the main symptom for 87 (79.82%) patients in the younger group (≥60) and 27 of the elderly patients (87.10%). There was a difference in the frequency of clicking and the occurrence of crepitation symptoms. TMJ clicking was experienced by 83 (75.15%) younger patients and much less by older patients (15, 48.39%), which was significant (chi-square test (df1) = 8.857 with $p = 0.0029$). Crepitation was more frequent in 13 (41.94%) elderly patients than in 17 (15.60%) patients under

Table 1 Differences between the tested groups of patients considering otalgia related to TMJ symptomatology, headache and bruxism behaviour.

Variables	≤59 year old (n = 110)	>59 year old (n = 31)	Chi-square test
Otalgia	63 (57.80%)	19 (61.29%)	0.1213; df = 1; $p = 0.728$
Headache	49 (44.95%)	19 (61.29%)	2.5786; df = 1; $p = 0.108$
Bruxism	50 (45.87%)	11 (35.48%)	1.0952; df = 1; $p = 0.303$

60 years of age, which was statistically significant (chi-square test (df1) = 9.945 with $p = 0.0016$).

There was a statistically significant difference ($t = 1.99$; df = 80.6; $p = 0.002$) in pain duration: the elderly reported shorter duration of experienced pain (7.8 months) than patients aged up to 59 (12.2 months). There was no difference ($t = 0.0953$; df = 1; $p = 0.758$) between patients' groups: patients aged up to 59/older patients which suffer TMJ pain during rest [42 (38.53%)/11 (35.48%)] or had pain occasionally during mandibular functioning [68 (62.39%)/20 (64.52%)]. There were no differences between patients aged up to 59 and older patients considering other, secondary diagnostic symptoms of TMJD: otalgia and headache (Table 1).

Difference in the wear of dental surfaces was found to be statistically significant (Table 2). Only patients under 59 did not have worn dental surfaces, while the frequency of tooth wear (degree 4 and 5) increased in the older patients. However, bruxism was found equally in patients under 59 and in the older patients (Table 1).

Measuring of active mouth opening did not show any statistically significant differences (Table 3). Counting the lost and non-replacement teeth in both jaws showed that there were no differences between the older patients and patients aged up to 59 (Table 3). In both groups, older patients and

patients aged up to 59, there were patients with all teeth preserved, and there were high maximal values of prosthodontically replaced teeth; 15 teeth in patients aged up to 59 and 20 teeth in older patients, both in the maxilla and in the mandible. Older patients had significantly more prosthodontic procedures carried out: as many as 70.97% of older patients had major prosthodontic procedures performed in the upper jaw and 64.29% in the mandible. Out of them, 38% of older patients wore complete dentures in the maxilla and 22.58% in the mandible, whereas in the group of patients aged up to 59, 4.59% wore complete dentures in the maxilla and 1.83% in the mandible. There were significantly more patients without prosthodontic procedures in the group of patients aged up to 59 (62.39% in the maxilla and 83.49% in the mandible) than in the group of older patients (25.81% in the maxilla and 29.03% in the mandible).

Older patients did not have significantly more pain intensity than patients aged up to 59 (Table 3). Higher values of anxiety in all patients were shown however with statistically significant difference: the mean scores in STAI 1 were 39.73 ± 9.59 older patients and 44.48 ± 8.70 for patients aged up to 59 ($t = 2.49$; df = 139; $p = 0.014$). In STAI 2, the scores were 40.28 ± 8.27 for older patients and 45.7 ± 9.32 for patients aged up to 59 ($t = 3.10$; df = 139; $p = 0.002$).

There were different borderline values of scores for anxiety on STAI for patients depending on their age (≤39, 40–49 and 50≥ years of age) and gender. For further analysis, only the patients with determined anxiety values of scores by STAI were chosen. There was a statistically significant share of elderly patients with increased anxiety according to the borderline values. Predominately older patients had anxiety: only one patient for STAI 1 and two patients for STAI 2 did not suffer from anxiety (Table 4).

Pain intensity on VAS and determined anxiety for each patient (scores over border values depending on age and gender.) was analysed. Only

Table 2 Differences between the tested groups of patients in the wear of dental surfaces.

Teeth wear	≤59 year old (n = 110)	>59 year old (n = 31)
Degree 1	13 (11.93%)	
Degree 2	35 (32.11%)	4 (12.90%)
Degree 3	24 (22.02%)	8 (25.81%)
Degree 4	35 (32.11%)	15 (48.39%)
Degree 5	2 (1.83%)	4 (12.90%)
Degree 6	1 (0.92%)	

Fisher's exact test $p = 0.0043$.

Table 3 Differences between the tested groups of patients considering measuring of active mouth opening, number of lost and non-replacement teeth, and pain intensity.

Variables	≤59 year old (n = 110)	>59 year old (n = 31)	t-test
Mouth opening (mm)	39.37 ± 8.30	39.81 ± 4.74	$t = 0.59$; df = 77.2; $p = 0.555$
Lost and non-replacement teeth (*N*)	1.80 ± 2.93	2.11 ± 4.20	$t = 1.61$; df = 37.1; $p = 0.116$
Pain intensity (VAS 0–10)	5.7 ± 1.99	6.2 ± 1.94	$t = 1.52$; df = 1.52; $p = 0.221$

mm, millimetres; *N*, number of teeth; VAS, visual analogue scale.

Table 4 Differences between the tested groups of patients depending on age and gender considering anxiety values of scores by STAI.

Higher anxiety on:	≤59 year old (n = 110)	>59 year old (n = 31)	Fisher's exact test (p)
STAI 1	63 (57.27%)	30 (96.77%)	9.624×10^{-6}
STAI 2	75 (68.18%)	29 (93.55%)	0.0047

STAI, State-Trait Anxiety Inventory

one patient for STAI 1 and two patients for STAI 2 were not suffering from anxiety in the group of older patients. In this group, another 30 patients had anxiety according to STAI 1 with mean value of pain intensity 6.15 ± 1.97 and 29 patients according to STAI 2 with mean value of pain intensity 6.15 ± 2.00. Comparison of pain intensity and anxiety in patients aged up to 59 showed no statistically significant differences for STAI 1 and STAI 2 (Table 5).

Comparison of anxiety according to pain experienced prior to visiting the dentist showed an identical distribution within older patients: only one of them was not suffering from anxiety according to STAI 1 and two of them according to STAI 2. The average length of experienced pain was 7.75 ± 9.64 months for older patients who had anxiety on STAI 1 and 7.81 ± 9.81 months who had anxiety on STAI 2. By observing the distribution in the group of patients up to 59 years of age, it was determined that there were statistically significant differences between them in the STAI 2 scale (Table 5).

Discussion

Contrary to the accepted knowledge about successive aggravation of musculoskeletal disorders, (especially degenerative joint disorders) during ageing[35], TMJD decreased with advanced age[3–5].

Many studies included general population of TMJD patients, and their results as well as the results of our study show that there is a wide range between 18 and 40 years of patients' age, with the oldest patient recorded at 90 years of age[3,5]. In our study, older patients were 22% of general TMJD patients' sample and the oldest patient was 82. This is a painful condition that is more prevalent in women than men, up to 90% of investigated population [3–5,7,10–12], with <10% of men in the TMJD group of older patients in our investigation.

TMJD as a painful condition[1,2,13] and connected with it, in our study, TMJ pain is the main symptom expressed in both groups of patients aged up 59 and older patients aged 60 ≥ . However, clicking or crepitation without pain in TMJ was found more often in elderly than in younger patients, who suffer more painful condition[4,28]. Taiwo et al.[11] found TMJ impairment (without differentiation of TMJ pain and joint sounds) in 17.42% of the total number oral pathologies of the investigated elderly people, in both sexes equally.

Schmitter et al.[4] found predominantly crepitation (21%) in the elderly subjects, in comparison with younger subjects aged between 18 and 45 years. We found TMJ clicking and crepitation in 48.39% and 41.94% of older patients, respectively, and in patients aged up to 59 with a greater difference of 75.15% and 15.60%, respectively. In our study, there was no significant increase in otalgia (61.9%) in older patients. Tuz et al.[9] determined a 63% prevalence of otalgia as the most common otological symptom involved with TMJD.

Van't Spijker et al.[18] confirmed that tooth wear is an inherent part of the ageing process, which means that it occurs continuously but slowly throughout life. In our study, more tooth wear (noticeable wear in the enamel or in the dentine) was found in older patients. Magnusson et al.[22] investigated contemporary human skulls and concluded that there was

Table 5 Comparison of the patients aged up to 59 according to anxiety distributed by age and gender as well as pain on the VAS and pain duration in months.

Variables	Anxiety – no (n; scores mean ± SD)	Anxiety – yes (n; scores mean ± SD)	t-test
Pain on VAS			
STAI 1	47; 5.33 ± 1.93	63; 5.95 ± 2.01	t = 1.63; df = 108; p = 0.106
STAI 2	35; 5.17 ± 1.97	75; 5.92 ± 1.97	t = 1.86; df = 108; p = 0.066
Pain duration			
STAI 1	47; 9.86 ± 14.37	63; 13.94 ± 16.44	t = 1.36; df = 108; p = 0.178
STAI 2	35; 7.17 ± 7.90	75; 14.54 ± 17.74	t = 3.01; df = 108; p = 0.003

VAS, visual analogue scale; STAI, State-Trait Anxiety Inventory.

no association between the degree of tooth wear and degenerative changes, which were closely related to TMJD in the elderly. In a review of the relationship between TMJD and bruxism, Manfredini and Lobbezzo[21] found no satisfying causal relationship. Matsuka et al.[16] found the reported frequency of symptoms in 30% and 34% of the adult population with TMD (including muscles disorder) teeth clenching and grinding. In our study, bruxist behaviour was found in 35.48% of older patients and in 45.87% of patients aged up 59. Gungormus and Erciyas[19] confirmed the relationship between psychological factors and bruxism: in the researched adult population with TMD, there were 58% with bruxism. Ciancaglini and al.[20] found temporomandibular pain in 46.6% of adults with bruxism. However, 31.5% of all investigated subjects selected from general adult population in this study had bruxism. In our study, a higher level of bruxism in both age groups of patients can be a reflection on high anxiety.

However, the majority of the sample had a poor dental status. Peroz and Prucha[23] found that the number of TMD patients undergoing prosthodontic treatment rises with age and that untreated, poor occlusion is not related to the increase in prevalence of TMJD. In our previously published study[24], we found that vertical occlusal dimension was preserved in 30% of patients with disc displacement of TMJ. However, elderly patients had significantly reduced vertical dimension, compared to patients in the youngest age group. Wang et al.[25] concluded that there was a significant relationship between missing posterior teeth and risk of TMD. In the sample of elderly prosthodontic patients with removable dental prosthesis, Dulčić et al.[12] found TMJ symptoms in only 9.3% of them. In our study of general TMJD patients, there were 38% of older patients with complete dentures in the maxilla and 22.58% in the mandible.

Bib and al.[8] reported that mouth opening of <40 mm was the most frequent sign of TMD. They measured the range of opening between 31 and 64 mm, and the upper value was higher than in our study. Obviously, patients have a significantly smaller capacity of mouth opening than asymptomatic persons (45.1 vs. 52.2 mm)[7].

Limchaichana et al.[7] showed that mean TMJ pain intensity on VAS was 7.4. Burris et al.[26] found in TMD patients a prevalent anxiety and mood disorder and lower pain intensity (VAS = 3.8); however, pain duration (13 months) was longer than in the results of our study. Giannakopoulos et al.[14] confirmed that anxiety plays a significant role as comorbidity with TMD-related orofacial pain.

Conclusion

In this study, it was determined that 22% were older patients and that MRI was a diagnostic standard for confirmation of clinical signs of TMJ disorders. A higher level of anxiety was shown in both patients' groups (patients aged up to 59 and older patients aged 60≥), regardless of shorter pain experience in older patients.

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Correspondence to:

Tomislav Badel, Department of Prosthodontics, School of Dental Medicine, University of Zagreb, Gundulićeva 5, 10000 Zagreb, Croatia.

Tel. ++3851 48 02 125

Fax. ++3851 48 02 159

E-mail: badel@sfzg.hr