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Pathomorphological Changes of the Temporomandibular Joints in the Course of Functional Disorders in Ultrasound Diagnostics

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Abstract

TMD is a disease within the masticatory system that increases its reach among the society every year in the third and fourth decade of life. The etiology of TMD is complex and it is often difficult to establish the cause in a specific case.

The aim of the study was to determine the quality of pathomorphological changes within the temporomandibular joints in the course of TMD assessed in ultrasound examinations. Material and methods. The study material included a group of 312 patients of both sexes, aged 20 to 44 years, who came for prosthetic treatment due to symptoms of TMD (pain of the masticatory muscles, limited opening of the mouth, popping and clicking in the temporomandibular joints) at the Department of Prosthetics and Orthodontics, Institute of Dentistry Jagiellonian University Medical College. Ultrasound examination of the temporomandibular joints supplemented the clinical diagnosis of TMD in all the subjects. Axis I of the DC / TMD was used

Result: Group I included 98 women and 52 men, group II consisted of 112 women and 50 men. Pathological morphological changes in the temporomandibular joints were found in all the examined patients. The changes in soft tissue structures were significantly increased in group II, but numerous pathomorphological changes were also present in the group of patients with the muscle form of TMD.

Conclusion: The results of the conducted studies revealed numerous pathomorphological changes within the temporomandibular joints and the need for additional diagnostic tests in the group of patients with TMD.

Keywords: Temporomandibular Disorders, Temporomandibular Joint Disorders, Ultrasonic diagnosis, Temporomandibular Joint

Abbreviations: TMD: Temporomandibular Disorders

Introduction

Temporomandibular disorder (TMD) is a disease that occurs within the masticatory system, Increasing its range among society every year, in the third and fourth decade of life. The number of patients with the pain form of this disease is systematically growing, and the age of patients reporting for treatment due to this dysfunction is getting lower [1-4].

The etiology of TMD is complex and we often encounter difficulties with determining the leading cause in a specific case, but a very important etiological factor is the patient's nervousness and psychoemotional disorders, as well as the pathological habits of biting and / or clenching teeth [5-10]. In the treatment of TMD, occlusal splints, physiotherapeutic procedures, medications, exercises performed by patients and several other supportive methods are used [1,3,4,10-14].

Among the various forms of TMD, the dominant are the muscle and articular form, displacement of the articular disc without blockage (forms I a and II a according to RDC) [15- 17]. Occlusal parafunctions in the form of grinding or clenching of the teeth are considered to be one of the main etiological causes, but not the only one. Prolonged contraction of the muscles during these pathological habits causes the biochemical state of overloading the masticatory muscles and at the same time causes excessive loads occurring within the temporomandibular joints and displacement of the articular disc, most often in the anterior direction [4,7,10, 15- 19].

In the case of pathological displacement of the articular disc, a significant role is assigned to the attachment of the lateral pterygoid muscle to the anterior surface of the disc (about 30% of the fibers) and the mechanical, excessive pulling or jerking of the entire disc anteriorly during tooth clenching, when this particular muscle is active. Then, the contraction of this muscle contributes to pathology and changes in the disc's location within the joint [4,9,20-25].

Ultrasound examinations are a very valuable alternative to magnetic resonance imaging

- which is a standard - due to the much lower cost of the examination for the patient, moreover, ultrasound can be used in pregnant women and is much less burdensome for patients with claustrophobia, sensitive to noise and having a pacemaker [26,27].

The results of ultrasound examinations of joints are very accurate and detailed. They include changes in articular surfaces, heterogeneity of the contour of the articulation surface, defective changes in the chondral surface, productive changes in the edge and articular surfaces, osteophytic production changes, abnormalities of the position of the articular disc - in occlusion and jaw opening (Figure 1,2). Ultrasonography offers many advantages, including reduced cost, accessibility, fast results, decreased examination time and lack of radiation exposure [28, 29].

The research was inspired by a small number of publications on this subject and the necessity to use additional treatment methods for temporomandibular joints in the case of morphological changes, e.g. intra-articular injections of hyaluronic acid or platelet-rich plasma, oral medications that improve soft tissue structures, as a supplement to the methods used so far [18].

The aim of the study was to determine the quality of pathomorphological changes within the temporomandibular joints in the course of TMD assessed in ultrasound examinations.

Material and Methods

The study material included a group of 312 patients of both sexes, aged 20 to 44 years, who came for prosthetic treatment due to symptoms of TMD (pain of the masticatory muscles, limited opening of the mouth, popping and clicking in the temporomandibular joints) at the Department of Prosthetics and Orthodontics, Institute of Dentistry Jagiellonian University Medical College. Ultrasound examination of the temporomandibular joints supplemented the clinical diagnosis of TMD in all the subjects. Axis I of the DC/TMD (International Network for Orofacial Pain and Related Disorders Methodology; 2018) was used in the diagnosis of dysfunction [15-17].

Two groups were distinguished among the treated patients: group I were patients with the muscle form of temporomandibular disorders (form I a DC/TMD - myofascial pain) and group II were patients with disc displacement with reduction (group II a). In all respondents a functional examination of the masticatory system according to the DC/TMD procedure was performed, assessing the clinical parameters in the range and symmetry of mandibular movements, mandibular abduction path, palpation of the masticatory muscles and temporomandib-

ular joints, acoustic symptoms in the temporomandibular joints and intraoral signs of occlusive parafunctions [1,5,15-17].

Additional examinations consisted of ultrasound examination of the temporomandibular joints with the use of the Philips iU22 apparatus, high -resolution linear array transducer and the 9-16 MHz head of the type of hockey stick, which was arranged linearly, parallel to the course of the zygomatic arch. The ultrasound examination of the joints was performed in the position of the central occlusion of the mandible and at maximum opening of the mandible, as well as in the dynamic state. The articular disks were assessed during static and dynamic examination. The patients were sitting on a chair, with their back resting on the backrest and their feet on the floor [17-21].

The inclusion criteria for the studies were: appropriate age range of patients, good general health, forms I a and II a according to the DC /TMD procedure, and consent of patients to participate in the studies. The exclusion criteria were the occurrence of general diseases that make it impossible to continue in the research, withdrawal of consent to participate in the project, and progression of illness to a more advanced form of TMD (II b) [15-17]

All participants agreed to participate in the research after explaining the purpose and stages of the research project.

Statistical analysis was performed using SPSS version 27. Basic descriptive statistics and chi-square and Fisher's exact tests were performed, and comparisons were made between groups 1 and 2 in terms of gender and the presence of r1 to r17 symptoms. A value of = 0.05 was used as the level of statistical significance.

The study was approved by the Bioethics Committee of the Jagiellonian University (No. 1072.6120.57.2018, April 20,2018)

Results

Group I consisted of 98 women and 52 men, group II - 112 women and 50 men.

Pathological morphological changes in the temporomandibular joints were found in all the examined patients. Table 1 contain the results of the type of pathological changes and the number of patients (percentage rating). The changes in soft tissue structures were significantly increased in group II, but numerous pathomorphological changes were also present in the group of patients with the muscular form of TMD – group I.

Table 1. Results of evaluation of pathomorphological changes of the right and lefttemporomandibular joints in groups I and II

		Right TMJ				Left TMJ			
		I group	I group	II group	II group	I group	I group	II group	II group
		F	M	F	M	F	M	F	M
	Symptoms	Totals = 98	Totals = 52	Totals = 112	Totals = 50	Totals = 98	Totals = 52	Totals = 112	Totals = 50
r1	Heterogeneity of the contour of the articulation surface	28 (28,57%)	21 (40,38%)	35 (31,25%)	23 (46,00%)	24 (24,49%)	18 (34,62%)	37 (33,04%)	20 (40,00%)
r2	Defective changes in the cartilage surface	7 (7,14%)	5 (9,62%)	21 (18,75%)	18 (36,00%)	8 (8,16%)	7 (13,46%)	17 (15,18%)	19 (38,00%)
r3	Retrograde sclerotic lesions thickening the grade 1 subchondral layer	41 (41,84%)	29 (55,77%)	62 (55,36%)	28 (56,00%)	35 (35,71%)	31 (59,62%)	47 (41,96%)	28 (56,00%)
r4	Retrograde sclerotic lesions thickening the grade 2 subchondral layer	7 (7,14%)	5 (9,62%)	35 (31,25%)	18 (36,00%)	5 (5,1%)	8 (15,38%)	27 (24,11%)	23 (46,00%)
r5	Retrograde sclerotic lesions thickening the grade 3 subchondral layer	4 (4,08%)	3 (5,77%)	21 (18,75%)	20 (40,00%)	4 (4,08%)	5 (9,62%)	25 (22,32%)	17 (34,00%)
r6	Osteophytic changes penetrating the edge of the articular surfaces	5 (5,1%)	4 (7,69%)	12 (10,71%)	10 (20,00%)	9 (9,18%)	11 (21,15%)	10 (8,93%)	14 (28,00%)
r7	Defective changes in the cartilage surface	2 (2,04%)	3 (5,77%)	14 (12,5%)	9 (18,00%)	4 (4,08%)	6 (11,54%)	10 (8,93%)	11 (22,00%)
r8	Defective changes of the articulation surface	5 (5,1%)	9 (17,31%)	17 (15,18%)	15 (30,00%)	4 (4,08%)	4 (7,69%)	16 (14,29%)	11 (22,00%)
r9	Broken ligament of the disc	2 (2,04%)	0 (0,00%)	14 (12,5%)	7 (14,00%)	2 (2,04%)	4 (7,69%)	19 (16,96%)	9 (18,00%)
r10	Abnormal shape of the articular disc	5 (5,1%)	3 (5,77%)	15 (13,39%)	18 (36,00%)	2 (2,04%)	7 (13,46%)	10 (8,93%)	20 (40,00%)
r11	Abnormal position of the articular disc in the position of the central occlusion	5 (5,1%)	7 (13,46%)	18 (16,07%)	14 (28,00%)	0 (0,00%)	5 (9,62%)	14 (12,5%)	10 (20,00%)
r12	Incorrect position of the articular disc in the position of the jaws fully open	5 (5,1%)	7 (13,46%)	24 (21,43%)	22 (44,00%)	1 (1,02%)	2 (3,85%)	28 (25,00%)	30 (60,00%)
r13	Capsule synovial hypertrophy	21 (21,43%)	18 (34,62%)	23 (20,54%)	25 (50,00%)	12 (12,24%)	14 (26,92%)	29 (25,89%)	24 (48,00%)
r14	Moderate synovial hypertrophy of the articular surfaces	11 (11,22%)	4 (7,69%)	27 (24,11%)	14 (28,00%)	8 (8,16%)	5 (9,62%)	31 (27,68%)	30 (60,00%)
r15	Excessive amount of fluid in the joint cavity	2 (2,04%)	0 (0,00%)	9 (8,04%)	5 (10,00%)	3 (3,06%)	4 (7,69%)	10 (8,93%)	4 (8,00%)
r16	Abnormal mobility of the articular heads	4 (4,08%)	3 (5,77%)	14 (12,5%)	19 (38,00%)	7 (7,14%)	2 (3,85%)	25 (22,32%)	27 (54,00%)
r17	Abnormal width of the joint space	12 (12,24%)	9 (17,31%)	35 (31,25%)	24 (48,00%)	10 (10,2%)	11 (21,15%)	28 (25,00%)	21 (42,00%)

Statistical analysis of the collected test results showed symptoms r2, r4, r5, r9, r10, r12, r14, r16 and r17 occurred significantly more often on the right side of both men and women in group 2 than in group 1 (Table 2).

Table 2. Right TMJ and groups 1 and 2 comparisons.

	Female			**Male**		
	group 1	**group 2**	**p-value**	**group 1**	**group 2**	**p-value**
r1	28(28,57%)	35(31,25%)	0.673	21(40,38%)	23(46%)	0.567
r2	7(7,14%)	21(18,75%)	0.014	5(9,62%)	18(36%)	0.001
r3	41(41,84%)	62(55,36%)	0.051	29(55,77%)	28(56%)	0.981
r4	7(7,14%)	35(31,25%)	<0,001	5(9,62%)	18(36%)	0.001
r5	4(4,08%)	21(18,75%)	0.001	3(5,77%)	20(40%)	<0,001
r6	5(5,1%)	12(10,71%)	0.137	4(7,69%)	10(20%)	0.071
r7	2(2,04%)	14(12,5%)	0.004	3(5,77%)	9(18%)	0.055
r8	5(5,1%)	17(15,18%)	0.017	9(17,31%)	15(30%)	0.131
r9	2(2,04%)	14(12,5%)	0.004	0(0%)	7(14%)	0.005
r10	5(5,1%)	15(13,39%)	0.041	3(5,77%)	18(36%)	<0,001
r11	5(5,1%)	18(16,07%)	0.011	7(13,46%)	14(28%)	0.069
r12	5(5,1%)	24(21,43%)	<0,001	7(13,46%)	22(44%)	<0,001
r13	21(21,43%)	23(20,54%)	0.874	18(34,62%)	25(50%)	0.116
r14	11(11,22%)	27(24,11%)	0.016	4(7,69%)	14(28%)	0.007
r15	2(2,04%)	9(8,04%)	0.052	0(0%)	5(10%)	0.019
r16	4(4,08%)	14(12,5%)	0.03	3(5,77%)	19(38%)	<0,001
r17	12(12,24%)	35(31,25%)	<0,001	9(17,31%)	24(48%)	<0,001

In the group of women on the right side r7, r8 and r11 occurred significantly more often in group 2 than in group 1. In the group of men r15 occurred significantly more often on the right side in group 2 than in group 1. Figures 1, 2 and 3 graphically present the results of statistical analysis of changes in the right (Figure 3,4) and left (Figure 5) temporomandibular joints in women and men.

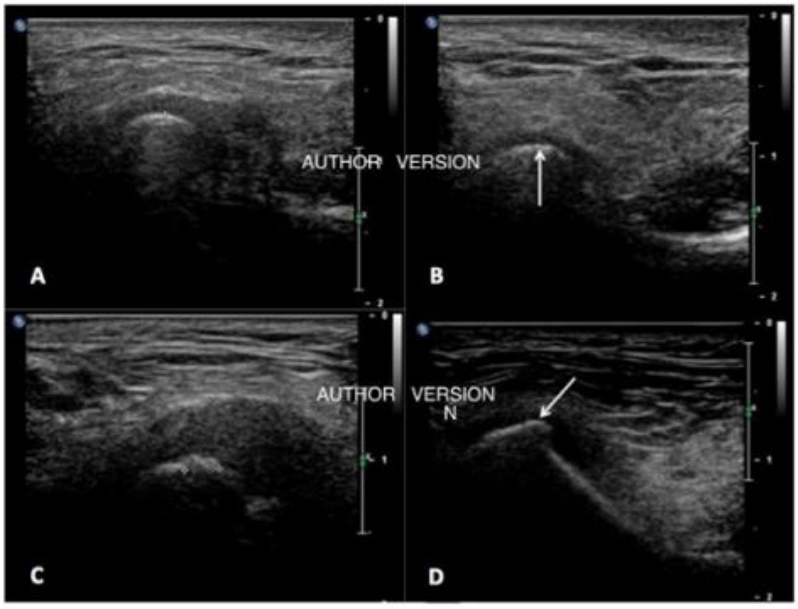

Figure 1: Different stages of condylar head articular surface degeneration visible on ultrasound pictures. Normal smooth surface of the condylar head (A). Subchondral sclerotic changes-typical for overload (arrow) (B). Cartilage destruction with penetration of productive changes (marked by clippers) (C). Osteophyte formation (arrow) (D)

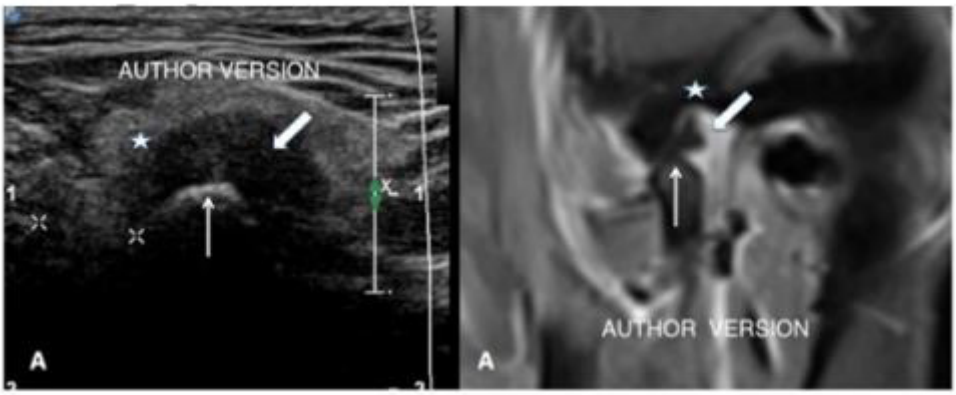

Figure 2: View of exudate causing increased width of the temporomandibular joint gap on ultrasound examination and MRI (star-glenoid fossa, thick arrow-disc, thin arrow-mandible condylar head.

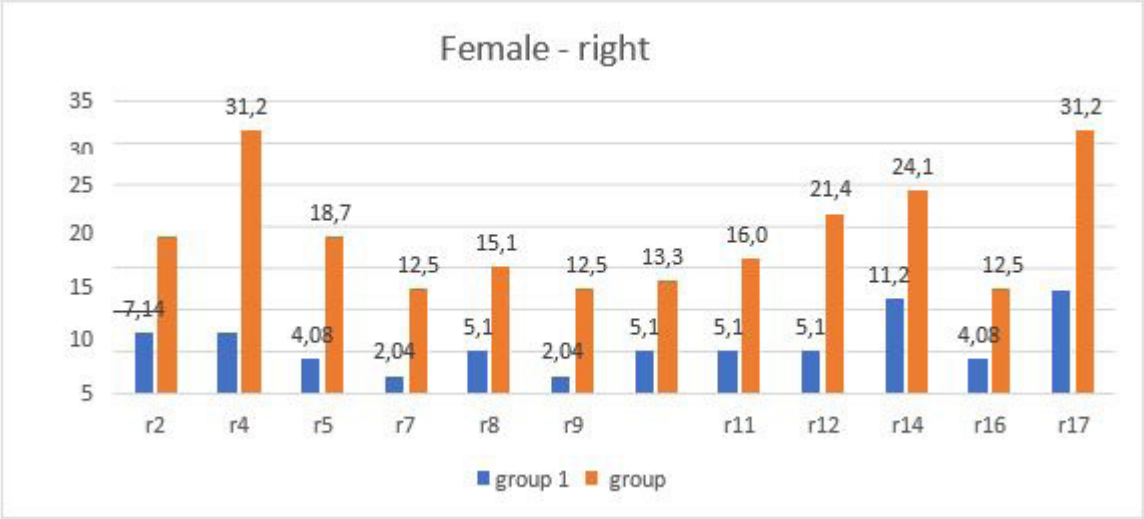

Figure 3: Graphical represenation of the results of statistical analysis for female in right TMJ

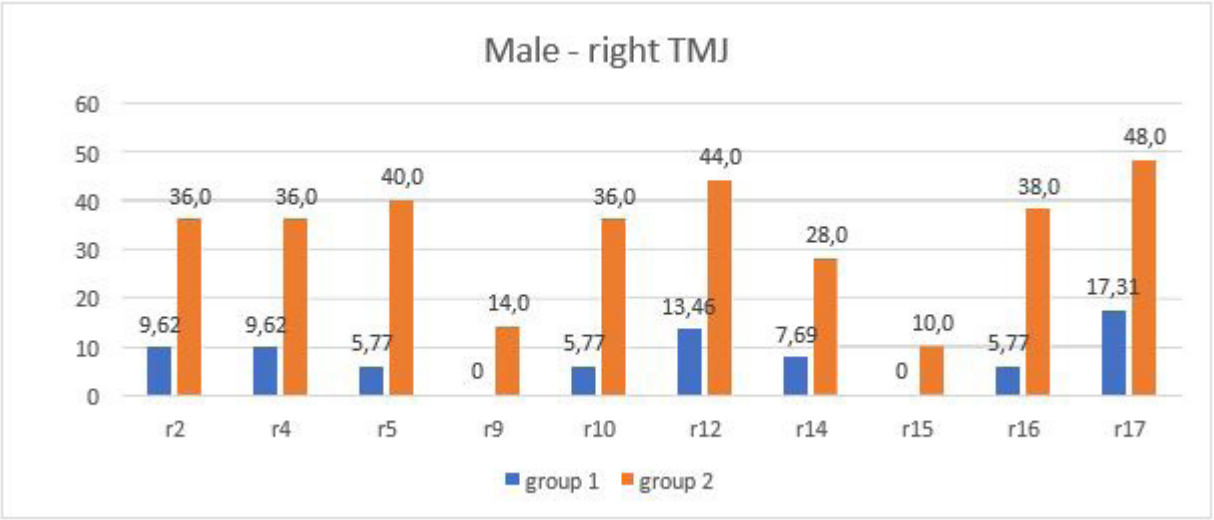

Figure 4: Graphical represenation of the results of statistical analysis for male in right TMJ

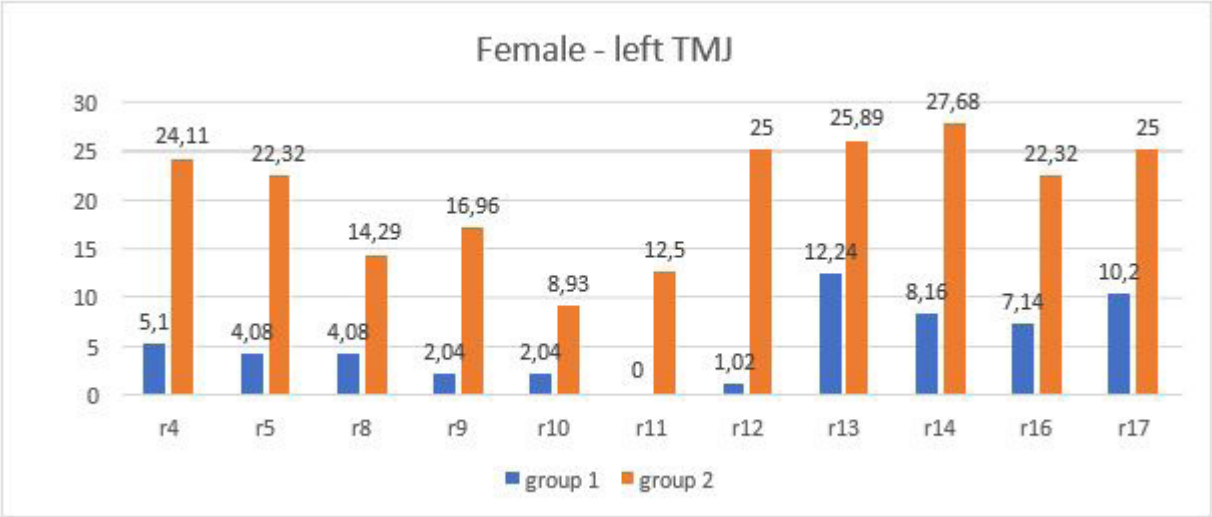

Figure 5: Graphical represenation of the results of statistical analysis for female in left TMJ

Symptoms r4, r5, r8, r10, r12, r14, r16 and r17 occurred significantly more frequently on the left side in both groups of men and women in group 2 than in group 1. In the group of women, r9, r11, r13 occurred significantly more often on the left side in group 2 than in group 1. In the group of men on the left side, r2 occurred significantly more often in group 2 than in group 1(Table 3).

Table 3: Left TMJ and groups 1 and 2 comparisons

	Female			**Male**		
	group 1	group 2	p-value	group 1	group 2	p-value
r1	24(24,49%)	37(33,04%)	0.174	18(34,62%)	20(40%)	0.574
r2	8(8,16%)	17(15,18%)	0.117	7(13,46%)	19(38%)	0.004
r3	35(35,71%)	47(41,96%)	0.354	31(59,62%)	28(56%)	0.712
r4	5(5,10%)	27(24,11%)	<0,001	8(15,38%)	23(46%)	<0,001
r5	4(4,08%)	25(22,32%)	<0,001	5(9,62%)	17(34%)	0.003
r6	9(9,18%)	10(8,93%)	0.949	11(21,15%)	14(28%)	0.422
r7	4(4,08%)	10(8,93%)	0.16	6(11,54%)	11(22%)	0.156
r8	4(4,08%)	16(14,29%)	0.012	4(7,69%)	11(22%)	0.041
r9	2(2,04%)	19(16,96%)	<0,001	4(7,69%)	9(18%)	0.119
r10	2(2,04%)	10(8,93%)	0.032	7(13,46%)	20(40%)	0.002
r11	0(0%)	14(12,5%)	<0,001	5(9,62%)	10(20%)	0.139
r12	1(1,02%)	28(25%)	<0,001	2(3,85%)	30(60%)	<0,001
r13	12(12,24%)	29(25,89%)	0.013	14(26,92%)	24(48%)	0.028
r14	8(8,16%)	31(27,68%)	<0,001	5(9,62%)	30(60%)	<0,001
r15	3(3,06%)	10(8,93%)	0.078	4(7,69%)	4(8%)	0.954
r16	7(7,14%)	25(22,32%)	0.002	2(3,85%)	27(54%)	<0,001
r17	10(10,20%)	28(25%)	0.005	11(21,15%)	21(42%)	0.023

Discussion

Ultrasound examination (USG) is the non-invasive application of ultrasound for the examination and imaging of tissues in medicine and veterinary medicine. Joint examination is the primary diagnostic method in all pathologies of the musculoskeletal system. It is characterized by high accuracy, because it enables the detection of changes in organs with small dimensions (from 0.1 mm) and the assessment of the functioning of soft tissue structures during movements in the joints [26-30].

The results of the conducted studies indicate an unfavorable tendency, as even in the group of patients with the muscular form of TMD (I a) there are numerous pathomorphological changes in the temporomandibular joints, including third degree sclerotic changes 4.0% in women group and 5.8% in men for the right joint and, respectively, 4.1% in women and 9.6% in men within the left joint. In the group of patients with TMD (II a), the most advanced changes occurred in 18.8% of women and 40% of men for the right joint, and 22.3% of women and 34% of men for the left joint.

This also applies to pathomorphological osteophytic changes penetrating the articular surfaces, which occur in group I a of patients in 5.1% of women and 7.7% of men, and in group II a in 10.7% of women and 20% of men in the right joint, respectively. This is a significant percentage, especially considering the muscle form, where it could be assumed that there will be no pathological changes in the joints at all. Overall, it should be summarized that all assessed changes occur in a much greater proportion in the group of patients diagnosed with II a compared to group I a, but extended diagnostics and rehabilitation should be used in both study groups.

Wright E [31] in his study, explains in detail the close relationship between the development of pathomorphological changes in the temporomandibular joints and their excessive load, comparing the situation in the masticatory organ to pain in the knee joint and the patient's overweight. First of all, the orthopedist points out the necessity to lose excess weight as the main etiological factor of changes in the knee joint. It can also be concluded that combating pathological habits of clenching or teeth grinding (usually lasting for many years) may be the key therapeutic procedure due to the elimination of excessive loads on the temporomandibular joints and the regression of pathomorphological changes in soft tissue structures.

It should be emphasized that the results of ultrasound examinations of the temporomandibular joints are very detailed and concern all soft tissue structures. In the publication from 2018 Kumar LK at al. [32] emphasised that currently the ultrasound examination of the temporomandibular joints is gaining more and more popularity and its convenience in the case of having metal elements in the body (endoprostheses, vascular stents, pacemakers), or a significant excess weight of the patient, claustrophobia and lower the cost of the examination is an important element that determines the increasing frequency of using this diagnostic imaging method. The authors also highlight that it is a cheap, non-invasive and quick examination technique, widely available in most therapeutic clinic.

The detection of significant pathomorphological changes indicates the need for additional treatment methods, such as intra-articular injections of hyaluronic acid or platelet-rich plasma. Both of these materials administered intraarticularly cause a reparative effect for soft tissues and, along with the reduction of significant joint load (occlusal splints, the effect of physiotherapeutic procedures and the avoidance of occlusive para-functions), they constitute the most important direction of modern medical treatment of TMD [33-35]. The results of our own research indicate a significant percentage of morphological changes occurring even in the group of patients with the muscular form of TMD.

Klatkiewicz T et al. [26] emphasize that for the detection of degenerative changes within the temporomandibular joints using USG, it includes sensitivity, which is 94%, specificity 100%, and accuracy in 94%. For joint's effusion changes, sensitivity was 81%, specificity 100% and accuracy 95%, for changes in displacement of the articular disc, all the above parameters were 92%. Opponents of this method conclude that it is not a good diagnostic method of temporomandibular joints due to low sensitivity and high specificity in the diagnosis of articular disc displacement - Dupuy-Bonafe at al. [33]. The adverse aspect of the accuracy of the tests is the high dependence on the experience of the person performing the test and the lack of generally accepted standardization of steps and parameters related to specialized equipment. Diaz at all. [34] emphasize that the ultrasound examination of the temporomandibular joints may be a good tool to supplement the clinical trial today, not exposing patients to difficult access to the examination and high costs, as in the case of magnetic resonance imaging (MRI).

Kumar LK et al. [32] points out that the limitation of ultrasound examinations is insufficient diagnosis of articular disc displacement in the mesio-distal plane, but according to the authors of this publication [36], the clinical trial provides sufficient data to diagnose this form of dysfunction.

On the other hand, Diaz D at al. [34] makes a point that ultrasound shows only the lateral parts of the articular heads, while the medial parts are unattainable for this visualization.

Summary

Ultrasound examination is a non-invasive examination, safe for patients, open to the public. It can be performed regardless of the health burden of patients and pregnant women. The image of pathological changes detected in the ultrasound examination in the case of temporomandibular joints is sufficient for starting a treatment or is also a starting point for extending diagnostics.

Conclusion

The results of the conducted studies revealed numerous pathomorphological changes within the temporomandibular joints and the need for additional diagnostic tests in the group of patients with TMD.

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