CASE STUDY

VALUE OF ULTRASONOGRAPHY METHOD IN THE DIAGNOSIS OF TEMPOROMANDIBULAR DISORDERS AND PATIENT MANAGEMENT MONITORING. CASE REPORT

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ABSTRACT

Value of ultrasonography method in the diagnosis of temporomandibular disorders and patient management monitoring is underestimated. Application of ultrasonography in the diagnosis of patients with temporomandibular disorders in many countries is limited. The main advantage and feature of the method is the ability to conduct examination in dynamics (during the function). Its safety and availability allow applying the method often and at different stages of diagnosis and treatment. So, ultrasonography fully satisfies the needs of primary diagnosing. MRI remains the recognized «gold standard» for the diagnosis of temporomandibular disorders.

A case report which is presented, demonstrates the relevance and scope of diagnostic information obtained by ultrasonography, and their verification and clarification with the use of magnetic resonance imaging.

Upon comparing the results of USG and MRI described in the clinical case report, we can conclude that ultrasound is quite sensitive and specific in diagnosing anterior disc displacement and blocked movement of the head of the mandible.

KEY WORDS: Temporomandibular Disorders, Temporomandibular Joint, Diagnosis, Ultrasonography, Magnetic resonance imaging

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INTRODUCTION

Temporomandibular disorders have gained an increasing attention in modern society, with the development of additional methods of diagnosis and digitalization. This problem is studied intensively in all civilized countries. There is no unanimous opinion on the etiology and pathogenesis yet. It is unambiguously clear that such pathology lies at the intersection of specialties and is actively studied in dentistry, neurology, physiotherapy, psychotherapy, rheumatology etc.

At the same time, there is a problem of clear differential diagnosis in order to determine treatment strategy and monitoring with evaluation of long-term results. Comprehensive differential diagnosis of TMD is possible by conducting general clinical and special methods of investigation. The ability to correctly interpret the diagnostic information received takes on particular importance [1-3]. During the examination and diagnosis of temporomandibular disorder, it is necessary to follow the procedure of examination protocols for the patients with suspected TMD [4]. The search for examination algorithms, establishing diagnosis, clear classification and nosological forms, and, accordingly, treatment protocols remain the most discussed topics among researchers of this speciality.

According to various data, the incidence of temporomandibular disorders among population ranges from 12 to 85% [5]. Females of reproductive age, urban dwellers, are affected more often. Temporomandibular disorders are not a monopathy, and require a comprehensive clinical examination by various specialists with expanded conclusions, as well as specialized additional diagnostics. It is known that the evidence of temporomandibular disorders is often found in other diseases of both dental and general somatic origin. More than 30 diseases have already been identified, the symptoms of which may mimic temporomandibular disorders. Physicians looking for etiological factors in the development of such disorders should be knowledgeable about information from different fields of medicine, and be able to pool and analyze it. As practice shows, it turned out to be more difficult than expected [6].

The complexity of the situation is also associated with temporomandibular joints structure peculiarities, the coherence between masticatory muscles, general physical and emotional state of a patient, the presence of concomitant somatic pathologies. Sometimes, it is difficult to reveal this pathology at an early stage. This results in complications and chronicity of the process. Consequently, treatment is often ineffective.

The key role in the assessment of TMJ is played by radiological methods of examination: X-ray study, cone beam computed tomography (CBCT), magnetic resonance imaging (MRI), ultrasonography (USG). Each of these methods addresses certain tasks. Traditional X-ray study, orthopantomography (OPG) and zonography (ZG) allow

Table I. Informative value of different study methods, depending on hard or soft tissues of the joint involvement [2].

	Method of study and its informative value				
TMJ structures	**OPG**	**ZG**	**CBCT**	**USG**	**MRI**
Hard tissues					
Bone ankylosis	+	+	+++	-	+
Arthritis/ Arthrosis	+	+	++	++	+++
Developmental disorders	++	++	+++	-	+
Neoplasms	+	++	+++	+	+++
Fractures	++	++	+++	-	++
Soft tissues					
Intraarticular disorders (displacement of articular disc)	-	-	-	++	+++
Disc perforation	-	-	-	++	+++
Fibrous ankylosis	-	-	-	++	+++
Exudation	-	-		++	+++
Joint ligaments, muscles	-	-	-	++	+++
Articular capsule inflammation	-	-	-	++	++

(- method is not used, + method is rarely used, ++ method is often used, +++ the leading method of study of the structure specified)

obtaining information on the bone structures of the joint, assessing the joint space. CBCT method can be used to obtain TMJ images in different planes and to assess the bone structures of the joint. Assessment of soft tissue structures using these methods is impossible [7]. Assessment of articular disc, ligaments, muscle structures can be obtained by USG and MRI [8].

The results of works concerned with ultrasonographic method of TMJ examination have been published in the literature [7-19]. The comparative analysis of ultrasonographic method of imaging with other methods of TMJ diagnostics, first of all MRI is presented. MRI is described in the literature as the "gold standard" [13-17]. Those advantages: time, efficiency, cost-effectiveness cause USG to be an alternative method of diagnostics [18].

Therefore, the coordinated cooperation of dentists with a number of other specialists in finding etiological factors and prescribing the correct management remains relevant. The choice of appropriate method of diagnostics is the key to success in establishing a diagnosis and early treatment. Therefore, understanding the procedure of USG and MRI allows a dentist to correctly interpret the description of the results, and use them to the benefit of the patient.

CASE REPORT

Patient P., born in 1976 (41 years old). Complained of pain in the left parotid region at rest and during chewing, which lasted for about a month. Life history included craniocerebral injury of the frontal area on the right (road traffic accident 10 years ago), listhesis in the cervical spine, multinodular goiter (undergoes follow-up examinations and treatment by endocrinologist), the initial signs of osteoarthritis of both knees, hypotension, migraine. Results of clinical examination revealed minor facial asymmetry due to the reduced left side, reduced tone of masticatory muscles, mouth opening 38 mm, its trajectory is sharp deflection to the left, absent acoustic phenomena in the joints, pain in the left parotid region at maximal opening of mouth and protrusion, positive response on the left to the provocation compression test of TMJ. Intraoral examination: mucous membrane and periodontal tissues are unremarkable, class III defects of dentition of the mandible, subclass 1 by Kennedy, missing teeth 36 and 46. Occlusion: signs of orthognathic occlusion were found in the frontal region, teeth 16 and 26 in the lateral regions are below the occlusal plane due to the protrusion towards the defects of dentition of the mandible. Among additional examinations, the patient has two orthopantomograms: current one (Figure 1) and the one made 6 years ago (Figure 2), and ultrasonographic study of TMJ and masticatory muscles.

USG findings: anterior displacement of articular disc of the left TMJ with blocked movement of the head of mandible (without reduction). Initial degenerative changes of the head of the left TMJ. Due to the fact that USG was conducted in dynamics, and interpretation of the image for the dentist was complicated, proceeding from the extensive experience of the doctor, we give findings without the image. To specify the diagnosis and etiology of the disease, MRI of TMJ with closed and open mouth position, as well as dynamic MRI were prescribed (Figure 3).

MRI findings: anterior disc displacement in the left TMJ; secondary manifestations of osteoarthritis of the left TMJ with joint effusion, reactive changes of the left lateral pterygoid muscle.

Detailed comparison of the results of clinical examination with the results of follow-up surveys revealed signs of deforming arthrosis of the left TMJ in the acute stage.

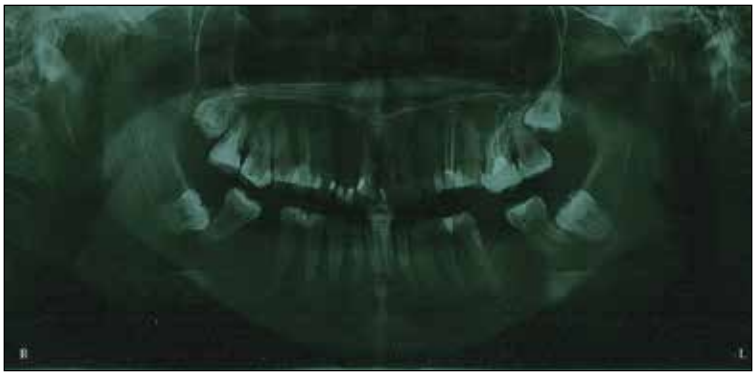

Fig. 1. Diagnostic orthopantomogram (2017)

Fig. 2. Diagnostic orthopantomogram (2011)

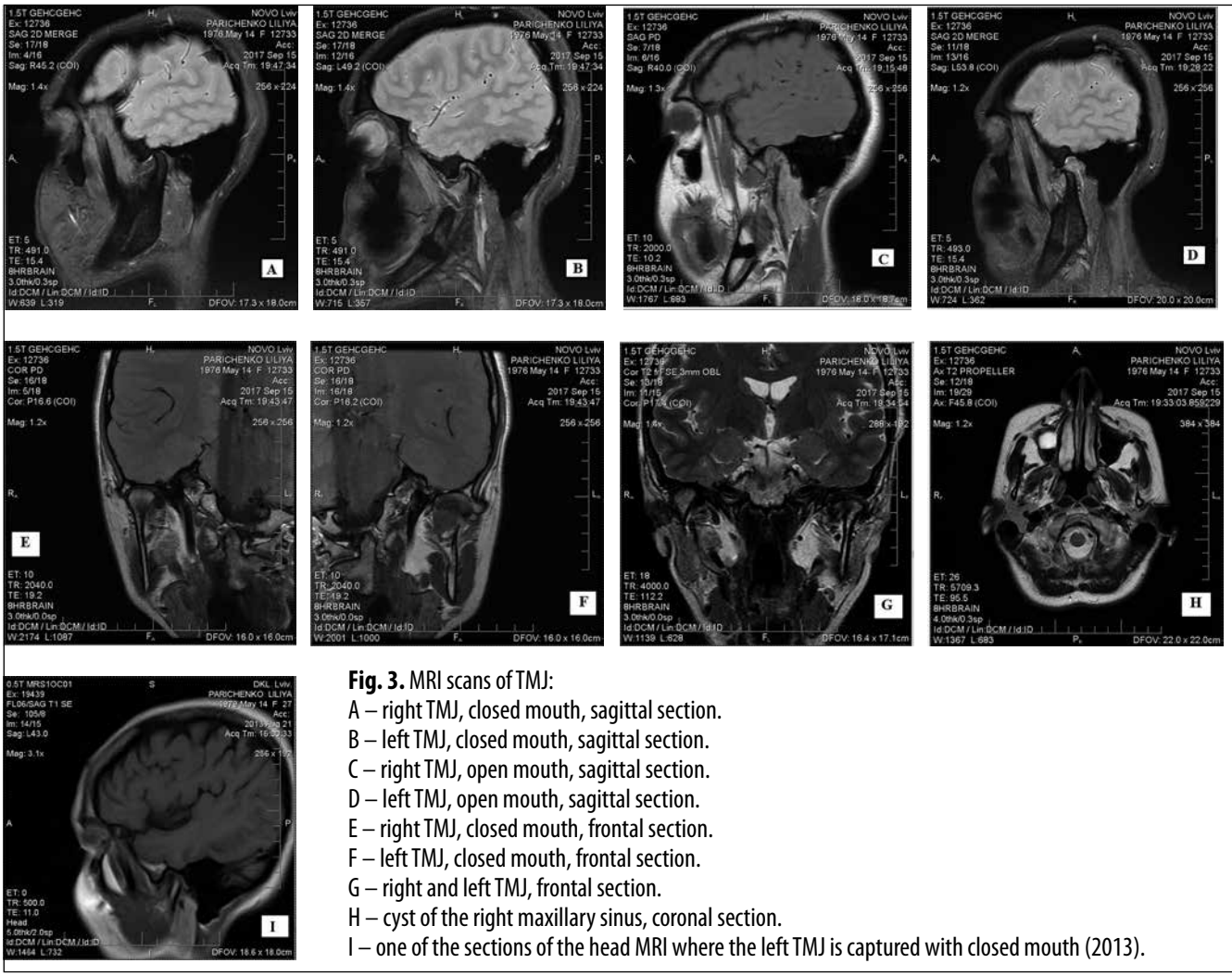

Fig. 3. MRI scans of TMJ:
A – right TMJ, closed mouth, sagittal section.
B – left TMJ, closed mouth, sagittal section.
C – right TMJ, open mouth, sagittal section.
D – left TMJ, open mouth, sagittal section.
E – right TMJ, closed mouth, frontal section.
F – left TMJ, closed mouth, frontal section.
G – right and left TMJ, frontal section.
H – cyst of the right maxillary sinus, coronal section.
I – one of the sections of the head MRI where the left TMJ is captured with closed mouth (2013).

MRI scan of the brain for 2013 revealed that the deformity of the condyle took place back then (Fig. 3-G). It should be noted that orthopantomograms for 2017 and 2011 did not reveal any deformities of the condyle, which confirms the relevance of a thorough clinical and follow-up radiological surveys.

The patient was referred for additional consultations to rheumatologist, ENT doctor due to maxillary sinus cyst, and dental therapist to rule out or confirm the odontogenic origin of maxillary sinus cyst. The patient was prescribed a number of follow-up examinations, including maxillofacial CT. Some CT sections are shown in Figure 4.

After a course of drug therapy prescribed by rheumatologist and endocrinologist, mandibular stabilization bite splint to be used at night and 1 hour during the day was made for the patient. Clinical picture after 2 months of using the bite splint and its regular corrections: opening of mouth for 50 mm, normal movement trajectory, no discomfort at opening of mouth, absence of response to the provocation compression test of TMJ. A control USG

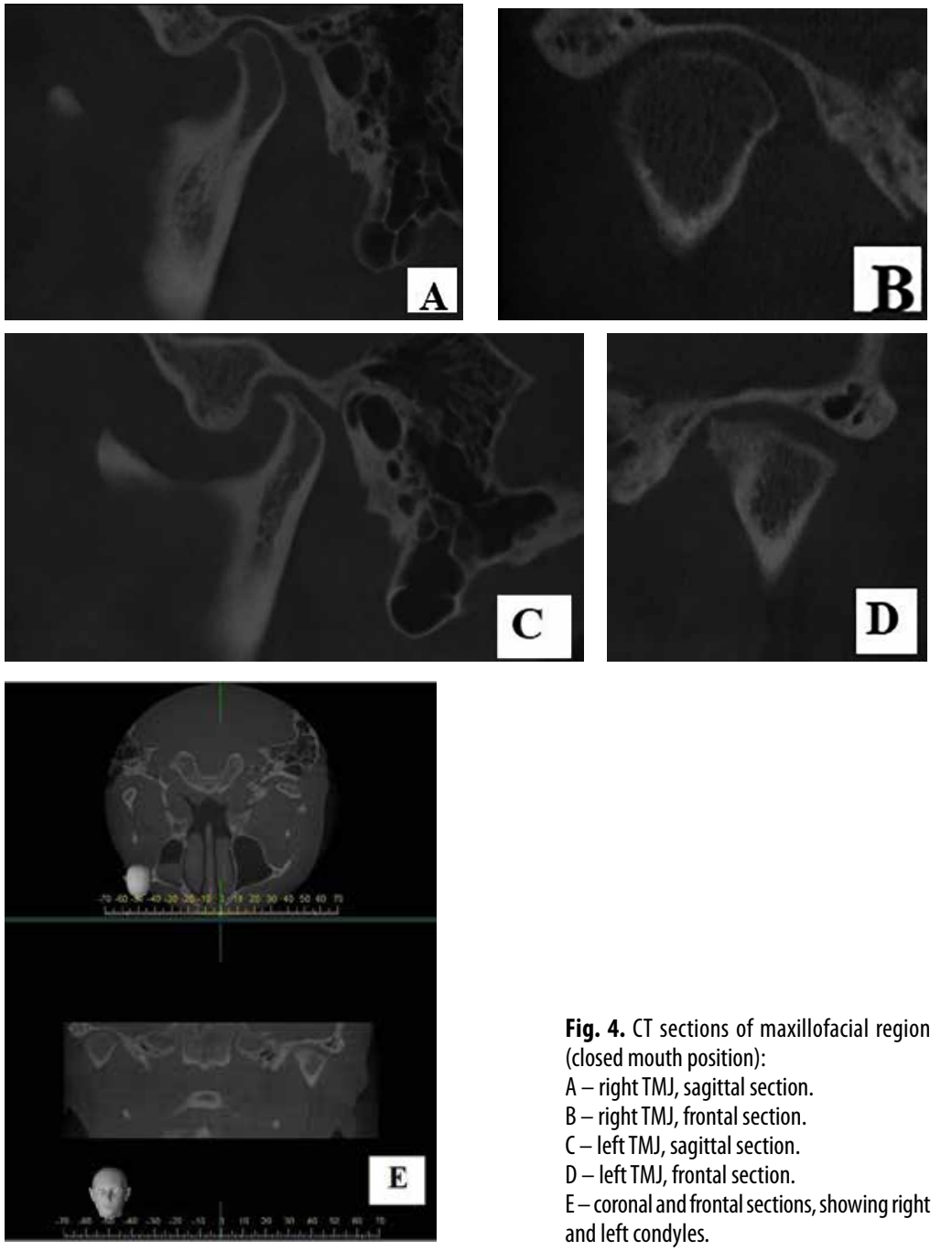

Fig. 4. CT sections of maxillofacial region (closed mouth position):
A – right TMJ, sagittal section.
B – right TMJ, frontal section.
C – left TMJ, sagittal section.
D – left TMJ, frontal section.
E – coronal and frontal sections, showing right and left condyles.

examination reveals normal discs positioning, the same initial degenerative changes of the head of the left TMJ, amplitude in both joints is 16 mm.

ULTRASONOGRAPHY

Visualization of TMJ and disc using USG was first reported by Nabeih and Speculand [19]. Stefanoff et al. reported successful results of evaluation of the TMJ disc in asymptomatic volunteers using USG [20]. Study of *Bas et al. has shown* that USG *provided a sensitivity of 69%* in the *detection of internal* derangements, *while high resolution* ultrasonography (*HR-US*) *showed a sensitivity between 65-95%* in the *determination of TMJ disorders* [21-24].

Other researchers think that examination of temporomandibular joint with the help of high-frequency ultrasound is a diagnostic method of unconfirmed effectiveness. The majority of studies focused on assessing pathological conditions rather than the condition of healthy joints to determine the correct USG image [25]. Dynamic ultrasonography turned out to be a reliable diagnostic tool for detection of normal disc position. The results of this study are of additional interest and should encourage research as to its potential uses and diagnostic capabilities [26]. A large number of studies in the literature deal with the use of USG for determination of anterior disc displacement. However, researchers draw attention to the failure of ultrasonography

to detect lateral and posterior displacements [12]. Nevertheless, there is a need for an inexpensive, non-invasive and simple diagnostic technique for temporomandibular joint imaging. High-frequency ultrasonography seems to be promising thanks to technological advances that provide more powerful transducers [25].

The principle of ultrasonography is based on the fact that the ultrasonic waves emitted by the device (transducer) pass through TMJ and are partially reflected in transit through various anatomical structures. Then the reflected sound waves are read by the same emitting device and transferred to the image [27,28]. The possibility of conducting dynamic survey, which enables to evaluate smooth function of TMJ, movement amplitude of condyles, the synchronism of motion of the head and disc is its feature and the greatest advantage. Ease of execution, accessibility, low invasiveness, unchanged normal posture of a patient, absence of radiation exposure and higher density of units if compared to MRI contributes to the increasing use of USG in the diagnosis of TMD [28,29]. Scope of diagnostic information obtained with the use of ultrasound combined with orthopantomography or computed tomography is meaningful enough for the diagnosis at the initial stage [8,30]. Appropriate qualifications of operators allow obtaining satisfactory result and minimizing discrepancies in the analysis of diagnostic data.

The TMJ area comprises various structures that reflect sound waves in different ways. The bone tissue represented by the head of the articular process and the articular tubercle is usually hypoechoic (low reflection of sound waves). Its images on ultrasonography are black, but the edge of the bone is hyperechoic (strong reflection of sound waves) and appears white in ultrasonographic images. The connective tissue represented by the articular capsule and the retrodiscal tissue (bilaminar zone), the muscular tissue represented by the lateral pterygoid and masticatory muscles, are isoechoic (intermediate reflection of sound waves) and appear unevenly gray on ultrasonography images. However, the surface of the articular capsule and the surface of the muscles strongly reflect sound waves that generate a hyperechoic (white) line. Empty space and water (upper and lower chambers) of the joints are hypoechoic and appear black on ultrasonographic images, but these anatomical cavities are virtual, because the opposite surfaces are in contact and are usually not detected during the examination if there is no effusion. The disc, like all major ligaments, consists of dense fibrous tissue, but its appearance on ultrasonographic images is contradictory [27].

Ultrasonography is performed in two positions: in the supine and in the sitting positions, in a state of habitual occlusion. During the examination, the patient's head is turned in the direction opposite to the site under examination. To evaluate the condition of the TMJ structures, three main approaches are used: a horizontal scan (the transducer is placed under zygomatic arch at an angle of 38-45 ° to the horizontal plane) and two frontal scans: posteriad and anteriad to the head of mandible, respectively, the transducer is placed in frontal plane under zygomatic arch at an angle of 45° anteriad [31].

At the first stage of the study, the examination, performed in horizontal scan, evaluates the upper lateral region of the head of mandible; the lateral fragment of the articular capsule; the presence of joint fluid; capsule-condyle distance; the lateral fragment of the articular disc and its position; the acoustic shadow from the bone tissue of the articular tubercle; the lateral pterygoid muscle (upper and lower heads); the masticatory muscle (superficial and deep regions); periarticular soft tissues. At the same time, scans perform a functional test (opening and closing of mouth) in order to determine movement amplitude of the head of mandible [31].

The second stage is the examination in the frontal scan in two positions: posteriorly from the head of mandible and anteriorly from the head of mandible. The transducer is placed in the frontal plane under zygomatic arch at an angle of approximately 45°, posteriad and anteriad to the head of mandible respectively. In this case the posterior lateral region of the head of mandible, the neck of the articular process of mandible, the posterior margin of the branch of mandible, the posterolateral fragment of the articular capsule, the bilaminar zone, the lateral part of the posterior (anterior) portion of the articular disc are evaluated. Disc visualization cannot be obtained when the head of mandible and disc are deeply located [31].

In case of degenerative changes of the joint, ultrasonography detects bone growth (osteophytes) on the surface of the head of mandible, thickness loss of subchondral-cartilaginous complex, subchondral cysts, its roughness and fragmentation. The reduction in capsule-condyle distance is assessed in both horizontal and frontal scans. In the presence of effusion in the joint, an increase in its dimensions is established, which is a confirmation that degenerative changes of TMJ may be accompanied by inflammatory process. Also, a decrease in the movement amplitude of the condyle and asynchrony of motion of the head and disc at maximal opening of mouth are found [31].

Informative value of different study methods, depending on hard or soft tissues of the joint involvement [2] is presented in Table I.

Magnetic resonance imaging is based on the use of electromagnetic radiofrequency non-ionizing radiation. In order to obtain an image, the patient is placed inside a strong magnetic field, which causes setting of the hydrogen atoms nuclei protons in accordance with the polarity of the field. With the use of radio signal, energy magnitude released is utilized for computer reconstruction of magnetic resonance imaging [31, 4].

During magnetic resonance imaging of TMJ, T1 and T2 – weighted images with closed and open mouth are made. T1-weighted images are made in order to visualize bone tissue and articular disc. T2-weighted images are made to detect inflammatory changes and fluid in TMJ. With the help of the "rapid scan" function, one can examine TMJ during opening and closing of mouth, i.e. in motion. MRI is also informative for changes in ligaments, articular discs and masticatory muscles [32-34].

MRI allows high performance determination of such pathologies as anterior displacement of the articular disc

with or without reduction, disc displacement in the medial and lateral directions in the coronal (frontal) plane. T2 image better demonstrates possible myxoid (mucosal) degeneration of the articular disc, but this sequence requires more time for MRI survey. The posterior adhesion of the articular disc (bilaminar zone) of TMJ is a highly plastic tissue involved in the redistribution of fluid (blood, tissue fluid, synovial fluid), able to change its volume in a wide range. With the use of MRI, one can assess its structure and volume depending on the position of the condyle. MRI is used to study the function of the masticatory muscles at rest and in dynamics. Edema and effusion in the lateral pterygoid muscle may be detected in 80% of patients with TMD on T2-weighted images. Thus, MRI leaves behind all other methods of study in many respects [31].

This method provides the best resolution in visualization of TMJ tissues, being non-invasive, not based on the use of ionizing radiation (complete safety for the patient and the staff), enables to obtain a multiplanar image without moving the patient, natural contrast of moving blood and absence of artifacts of bone elements [31].

Disadvantages of this method include long examination time, restricted use in patients with pacemakers, implants containing ferromagnetic alloys, in pregnant women, as well as in patients with claustrophobia, and the high cost of diagnosing [31]. The MRI method does not allow assessing both the TMJ function and its structure [18,25]. Examination with opening and closing of mouth is not informative due to the complexity of technological process and low frequency [8]. Quality of the results obtained is directly dependent on the qualifications of operators, their skills and experience of work with the unit.

CONCLUSIONS

MRI remains the recognized "gold standard" for the diagnosis of temporomandibular disorders. However, despite the lack of sufficient number of scientific research, ultrasonography fully satisfies the needs of primary diagnosing. Its combination with one of radiological diagnostic methods gives a comprehensive picture of the state of the structures of temporomandibular joints. The particular advantage of USG over all other methods is the procedure in dynamics and in real time, giving unique data on joint function. Upon comparison of the results of USG and MRI described in the clinical case report, we can conclude that USG is sufficiently sensitive and specific. Its basic utilization during the initial examination gives a doctor an orientation for further diagnosis and follow-up consultations. Attention is drawn to the fact of high quality assessment of the state of subchondral-cartilage complex and an early-stage degenerative changes of the condyle with the help of USG, which can be used to clarify the diagnosis in patients with restricted use of MRI examination. Absence of harm to a patient allows the use of this method often to monitor management, while the complexity and restricted application of MRI do not always justify results; so it does not always make sense. The study of ultrasonography as a diagnostic tool in the detection of TMD remains open and requires further research. However, MRI should be used, if possible, for acquisition of knowledge of TMJ structures visualization, gaining in experience by radiologists and an increased application of MRI in dentistry.

REFERENCES

1. Manfredini D. Current concepts on temporomandibular disorders. London, Berlin, Chicago: Quintessence publishing Co. 2010, 498p.
2. Telishevska U. Dyferentsiyna diahnostyka skronevo-nyzhnoshchelepnykh rozladiv za klinichnymy ta renthenolohichnymy oznakamy [Differential diagnostics of temporomandibular disorders by clinical and radiographical signs]: avtoref. dys. na zdobuttia nauk. stupenia kand. med. nauk: spets. 14.01.22. «Stomatolohiia»; Lviv. 2010, 19p.
3. Talmaceanu D., Lenghel L.M., Bolog N. et al. Imaging modalities for temporomandibular joint disorders: an update. Clujul Med. 2018;91(3):280-287. doi: 10.15386/cjmed-970.
4. Telishevska O. Differential diagnosis of temporomandibular disorders with the use of a developed computer program for determining the individual risk of their development. "Ukrainian Dental Almanac". 2016; 4: 75-80.
5. Murphy I. Temporomandibular disorders: manual therapy, exercise and needling. Br Dent J. 2019;226: 6. doi: 10.1038/sj.bdj.2019.28.
6. Telishevska O.D. Obhruntuvannia kliniko-diahnostychnykh kryteryiv dyferentsiynoi diahnostyky skronevo-nyzhnoshchelepnykh rozladiv ta khvorob, shcho yikh imituiut [Rationale for clinical diagnostic criteria for differential diagnosis temporomandibular disorders and diseases that mimic them]. Lviv. 2017, 406p.
7. Matsubara R., Yanagi Y., Oki K. et al. Assessment of MRI findings and clinical symptoms in patients with temporomandibular joint disorders. Dentomaxillofac Radiol. 2018;47(4):20170412. doi: 10.1259/dmfr.20170412.
8. Makieiev V.F., Kucher A.R., Rybert Yu.O., Zhyznomyrska O.O. Ultrasonohrafy of temporomandibular joint. The first visualization experience. Dental news. 2013;3:62.
9. Ahmad M., Schiffman E.L. Temporomandibular Joint Disorders and Orofacial Pain. Dent Clin North Am. 2016;60(1):105-24. doi: 10.1016/j.cden.2015.08.004.
10. Elias F. M. Ultrasonographic findings in normal temporomandibular joints. Brazilian Oral Research. 2006;1(20):338–343. . doi: 10.1590/S1806-83242006000100006.
11. Emshoff R., Jank S., Bertram S. et al. Disk Displacement of the Temporomandibular Joint: Sonography Versus MR Imaging. American Journal of Roentgenology 2002;178(6):1557-1562.
12. Manfredini D. Ultrasonography has an acceptable diagnostic efficacy for temporomandibular disc displacement. Evid Based Dent.2012;(13)84–85. doi: 10.1038/sj.ebd.6400878.
13. Jank S., Emshoff R., Norer B. et al. Diagnostic quality of dynamic high-resolution ultrasonography of the TMJ—a pilot study. International Journal of Oral and Maxillofacial Surgery 2005; 34(2):132-137. doi:10.1016/0030-4220(89)90337-X.
14. Junior Mello C., Saito Cassio O., Filho H. Sonographic evaluation of temporomandibular joint internal disorders. Radiol Bras. 2011;44(6):355.
15. Shoukri B., Prieto J.C., Ruellas A. et al. Minimally Invasive Approach for Diagnosing TMJ Osteoarthritis. J Dent Res. 2019;98(10):1103-1111. doi: 10.1177/0022034519865187.
16. Talmaceanu D., Lenghel L.M., Bolog N. et al. High-resolution ultrasonography in assessing temporomandibular joint disc position. Med Ultrason. 2018;1(1):64-70. doi: 10.11152/mu-1025.

17. Evirgen Ş., Kamburoğlu K. Review on the applications of ultrasonography in dentomaxillofacial region. World J Radiol. 2016;8(1):50. doi: 10.4329/wjr.v8.i1.50.
18. Manfredini D., Guarda-Nardini L. Ultrasonography of the temporomandibular joint: a literature review. Int J Oral Maxillofac Surg. 2009;38(12):1229–236.
19. Nebeith Y.B., Speculand B. Ultrasonography as a diagnostic aid in temporomandibular joint dysfunction. A preliminary investigation. Int J Oral Maxillofac Surg. 1991;20(3):182.
20. Stefanoff V., Hausamen J.E., van den Berghe P. Ultrasound imaging of the TMJ disc in asymptomatic volunteers. Preliminary report. J Craniomaxillofac Surg. 1992;20(8):337.
21. Bas B., Yılmaz N., Gökce E., Akan H. Diagnostic value of ultrasonography in temporomandibular disorders. J Oral Maxillofac Surg. 2011;69(5):1304.
22. Byahatti S.M., Ramamurthy B.R., Mubeen M., Agnihothri P.G. Assessment of diagnostic accuracy of high-resolution ultrasonography in determination of temporomandibular joint internal derangement. Indian J Dent Res. 2010;21(2):189.
23. Emshoff R., Jank S., Rudisch A., Bodner G. Are High- Resolution Ultrasonographic signs of disc displacement valid? J Oral Maxillofac Surg. 2002;60(6):623.
24. Emshoff R., Jank S., Rudisch A. et al. Error patterns and observer variations in the high-resolution ultrasonography imaging evaluation of the disk position of the temporomandibular joint. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 2002;93(3):369.
25. Klatkiewicz T., Gawriołek K., Pobudek Radzikowska M., Czajka-Jakubowska A. Ultrasonography in the Diagnosis of Temporomandibular Disorders: A Meta-Analysis. Med Sci Monit. 2018;24:812-817. doi:10.12659/msm.908810.
26. Emshoff R., Bertram S., Rudisch A. The diagnostic value of ultrasonography to determine the temporomandibular joint disk position. Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology, and Endodontology. 1997; 84(6):688-696.
27. Melis M., Secci S., Ceneviz C. Use of ultrasonography for the diagnosis of temporomandibular joint disorders: a review. Am J Dent. 2007;20(2):73–78.
28. Merritt C.R.B. Physics of ultrasound. 2nd ed. St. Louis: Mosby; 1998, 55p.
29. Friedman S.N., Grushka M., Beituni H.K. et al. Advanced Ultrasound Screening for Temporomandibular Joint (TMJ) Internal Derangement. Radiol Res Pract. 2020. doi: 10.1155/2020/1809690.
30. Koh K.J., List T., Patersson A., Rohlin M. Relationship between clinical and magnetic resonance imaging diagnoses and fi ndings in degenerative and infl ammatory temporomandibular joint diseases. A systematic review. J Orofacial Pain. 2009;23:122-139.
31. Makieiev V.F., Telishevska U.D., Shybinskyi V.Ya. et al. Skronevo-nyzhnioshchelepni rozlady. [Temporomandibular disorders] Danylo Halytskyy Lviv National Medical University: Lviv; Kvart. 2018, 400p.
32. White S.C., Pharoah M.J. Radiologia Stomatologiczna.Lublin: Czeley Sp.z.o.o. 2002, 658p.
33. Zachariah G.P., Chandran S. Ultrasonography: A step forward in temporomandibular joint imaging. A preliminary descriptive study. Clin Pract. 2019;9(2):134134. doi: 10.4081/cp.2019.1134.
34. Al-Saleh M.A., Alsufyani N.A., Saltaji H. et al. MRI and CBCT image registration of temporomandibular joint: a systematic review. J Otolaryngol Head Neck Surg. 2016;45(1):30. doi: 10.1186/s40463-016-0144-4.

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