BULLETIN OF STOMATOLOGY AND MAXILLO-FACIAL SURGERY OF
Vol. 19, No. 1

DOI: 10.58240/1829006X-2023.19.1-92

ORIGINAL ARTICLE

REGISTRATION OF JOINT SOUND IN PATIENTS WITH DYSFUNCTIONS SYNDROME TMJ ASSOCIATED WITH OCCLUSION DISORDERS

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Received: *Nov. 28, 2022;* ***Accepted:*** *Dec. 28, 2022;* ***Published:*** *Jan. 15, 2023*

Abstract

The aim of the study is to develop a functional hardware method for determining and recording sounds in TMJ dysfunctions syndrome.

Material and methods: The study included 54 patients with temporomandibular dysfunction syndrome who had previously undergone endodontic dental treatment. All patients had occlusion disorders due to errors after dental filling restoration. To diagnose the TMJ, a CT scan was used. To optimize diagnosis of TMJ sound the modified portable device for determining TMJ sound and a computer program to analyze and process the data obtained were used. All the patients were given full-fledged endodontic treatment and restoration of the crown part, taking into account anatomical features. The complex therapy also included therapy and magnetic laser therapy.

Results: The dynamics of the complex treatment of patients diagnosed with TMJ dysfunction syndrome showed that after treatment, the clinical symptoms gradually decreased and disappeared at the end of treatment. CT scan a year after treatment showed a normal ratio of TMJ elements. Registration of sounds before treatment and after complex treatment showed a decrease and complete disappearance after 4 months.

Conclusions: The dysfunction syndrome TMJ is amenable to effective conservative treatment. Proposed modified portable device for determining TMJ sounds provides more accurate auscultation and analysis of sounds in dysfunctions syndrome TMJ, to record and store sounds in a digital or graphic image, makes it possible to analyze the dynamics of treatment.

Keywords: *dysfunctions syndrome TMJ, temporomandibular joint, occlusion disorder, sounds recording device*

Introduction

Temporomandibular joint (TMJ) disorders are a class of degenerative diseases of the musculoskeletal system connected with morphological and functional deformations. According to epidemiological data, TMJ disorders up to 25% of the population [1, 2]. TMJ disorders include anomalies in the intra-articular position and/or structure of the disc, as well as temporomandibular dysfunction (TMD) which is the second most common disease of the musculoskeletal

system, causing pain and disability (after chronic low back pain) [3, 4, 5].

Clinical observations show that numerous factors may play role in the progression of TMD and degenerative changes connected with it. These factors include injuries, parafunction, occlusion disorders, functional overload [6, 7].

The polyethological nature of this pathology, the complexity of the clinical picture and the diagnosis and treatment connected with it, of course, should be complex: relief of emotional stress (psychotherapeutic treatment), medication, physiotherapy, orthopedic, orthodontic occlusive and others [8-14].

Signs and symptoms of diseases and dysfunctions of the TMJ are different and depend on the duration of the disorders and their chronicity, as well as on the individual sensitivity of patients [15, 16].

Clinical symptoms of dysfunctions syndrome TMJ is manifested may include one or more of the following symptoms: temporomandibular joint pain, headaches, ear pain, muscle soreness, joint noises such as clicking, popping or grinding, limited opening or deviation of the mandible upon opening and occlusal changes due to changes in the position of the mandible. Therefore, correct identification of symptoms and accurate diagnosis are essential for future treatment.

Due to the complex and unique nature of each TMJ case, diagnosis requires an individual analysis of the patient, followed by various diagnostic modalities. Similarly, it requires individual treatment taking into account specific characteristics of each patient's disease.

Patient's condition evaluation along with various imaging methods can help to determine the stage of disease, to diagnose and plan the treatment. The assessment of the TMJ begins with a thorough history and clinical examination. In some cases, clinical examination data is enough for the preliminary diagnosis and start conservative treatment. However, other patients will require diagnostic imaging of the TMJ to provide information that is not available on clinical examination [17]. As a result, TMJ identification can include any combination of the following diagnostic methods: magnetic resonance imaging (MRI), computed tomography (CT), simple and panoramic radiography, arthrography. CT scan is considered the most useful for visualizing the TMJ bones while MRI is considered the most useful for soft tissues visualization, including the disc and its articular ratio. Arthrography is an invasive intra-articular examination; its usual indication is visualization of changes in the articular disc. Due to the inherent risk of this method, it has been superseded by MRI evaluation [18-21]. Ultrasonography (US) examination, can be a useful option in the assessment of disc position in internal TMJ disorders. Ultrasound is indicated when MRI is contraindicated, to differentiate between TMJ and painful conditions of the major salivary glands [22-24].

One of the symptoms of dysfunctions syndrome TMJ is sound in the joint area while opening and closing the mouth. In this regard, electrosonography is a productive method, as it allows you to fill in the missing information characterizing the TMJ condition [25-26]. Because electrosonography can pick up sounds that we have difficulty hearing, it can help us detect TMJ early. Electrosonography also helps us accurately characterize sounds. By looking at the specific shape of the sound waves on the electrosonograph, we can understand exactly what is happening in the jaw joint in order to make a more accurate diagnosis. Joint sounds are analyzed by the computer in terms of amplitude and frequency present depending on their occurrence in the opening and closing cycles. It is a valuable adjunct used in conjunction with other clinical diagnostic methods to confirm such joint pathology conditions. Especially when we can combine it with other CT scan data and other measurements.

Amplitude, frequency, duration and location of joint sounds can be recorded to identify and quantify different levels of joint health. This allows us to see if the TMJ is getting worse or if treatment is helping to reduce stress on the jaw joints. Claims for the use of sonography to distinguish between different intracapsular conditions of the TMJ have not been supported by well-designed studies [27-29]. The use of additional functional methods in patients with TMJ can improve the efficiency of diagnosis and monitor the dynamics of treatment.

The aim of the study is to develop a functional hardware method for determining and recording sounds in TMJ dysfunctions syndrome.

Material and methods

The study included 54 patients (males 28, females 26, the age range was 26-48 years with a mean of 35.2 years) with clinical features consistent with TMJ dysfunctions syndrome were enrolled who had previously undergone endodontic dental treatment. Patients examined for pain on palpation, at rest/during movement, muscle pain, sound on jaw movement. The symptoms and signs included pain around the joint, in the pre-auricular region, in the muscles of mastication and the ear, limited or abnormal range of motion, and cranial and/or muscle pain, sound in the joint area while opening and closing the mouth.

Based on the clinical analysis of the patients with TMJ dysfunctions, can state that almost all the patients had occlusion disorders due to errors in dental filling.

When examining the fillings, much attention was paid to the marginal fit of the filling, contact points, height in relation to the antagonist teeth, and the state of the periapical tissues. Based on x-ray studies, the quality of root canal filling was determined. To diagnose the TMJ, a CT scan was used, which provided information about the condition of the tissues, the position of the axes of the joint heads (fig. 1).

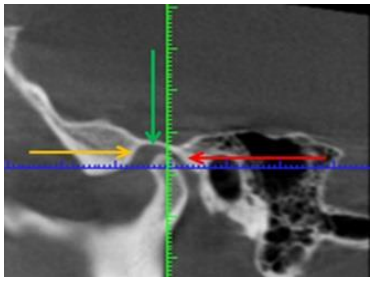

Figure 1: Computer tomography (CT) before treatment

To optimize the differential diagnosis of joint sound the ESGI apparatus and a computer program to analyze and process the data obtained were used. To detect and record sound in TMJ with higher accuracy, have developed a method to record sound by converting an audio signal into an electrical one. The aim is to reduce the level of signal distortion and ease of device use. An ultra-sensitive microphone, built into the microphone of the hearing aid for a more accurate and high-quality assessment of the TMJ condition, was used. This functional method in electronic form makes it possible to analyze the treatment dynamics, to record and store in a digital or graphic image.

The sound recording device consists of a microphone, a hearing aid that amplifies the signal, a sound guide, and a computer connected to the microphone output (fig. 2).

Figure 2: General view portable device for determining TMJ sounds

The device has a mechanical vibration sensor (1) connected to each other, an electrical signal amplifier (2) and a computer with a program for processing and recording signals (3). The body of the device is in the form of headphone with a spring arc (4), a sensor (1), an autonomous power source (6), and an electric signal amplifier (2). The sensor (1) and the amplifier (2) are connected to the power supply (6), i.e., they have a common power supply. Amplifier output (7) is connected to the computer (3) by a cable. The second part of the headphone (8) has an additional (auxiliary) function and does not contain any active nodes, it only provides a reliable fit of the body (5) to the examined temporomandibular joint.

To record and analyze acoustic sounds, any computer with an appropriate program is used which allows to standardize acoustic parameters in a three-coordinate system (time-frequency-intensity). An ultra-sensitive Cyber Sonik device is used as an electrical signal amplifier with the following characteristics. Sound intensity is the strength of a sound wave (amplitude) and is measured in decibels (“dB”), is normally from 10-30 dB.

The patient opened and closed his mouth with maximum amplitude, the sound was recorded using highly sensitive microphones, which were superimposed on the skin surface in the area of the joints. The recording was made during four cycles of opening and closing of the mouth. Further, the program performed noise analysis according to the above-mentioned parameters. Diagnostics of the TMJ condition was carried out by interpreting the obtained data. Normal function of the joints was characterized

by noiseless movement of the head joint during rotation and progression. In this case, the disc is always on the joint head, moving with it. Contraction of the superior belly of the lateral pterygoid muscle causes an anteromedial effect on the disc, and the elastic resistance of the retrocondylar tissues causes smooth movement of the joint head and disc.

Each patient's course of treatment was worked out basing on the clinical and X-ray assessment of the disease, the causes preceding its development and occurrence. In any case, if the patient complained of pain in the TMJ area, both at rest and during the lower jaw movement, treatment began with its relief. All the patients were given full-fledged endodontic treatment and restoration of the crown part, taking into account anatomical features under the control of X-ray diagnosis. To obtain the correct occlusal height, casts of the upper and lower jaws, diagnostic models were obtained, followed by their installation in the articulator, after the detection of supercontacts in the patient's oral cavity, they were occlusal adjustments.

All the patients were treated symptomatically. The complex therapy included analgesics, non-steroidal anti-inflammatory drug, muscle relaxants and relaxation therapies, topical analgesics gel. With the myogenic type of pain, used 10 sessions of magnetic laser therapy in the joint area. The CT data and sound recording were carried out before treatment, after 3 months and 6 months.

Results

51 patients complained of pain around the joint, pre-auricular region, muscles of mastication and the ear region, while 37 patients complained of pain on opening the mouth during mastication, 24 patients had impaired movement of the jaws, mouth opening was normal in 26 patients and reduced in 4 patients, deviation of the mandible on closing was observed in 14 patients. 49 patients complained of sounds, in 37 patients clicking sounds were elicited, with crepitus in 12 patients. All patients presented occlusion disorders due to errors after dental filling restoration. Complex treatment was effective in 87% of patients, after 3-5 months gradually decreased pain, noise in the joints, restriction of opening and closing of the mouth disappeared. Patients recovered their chewing functions, psycho-emotional state.

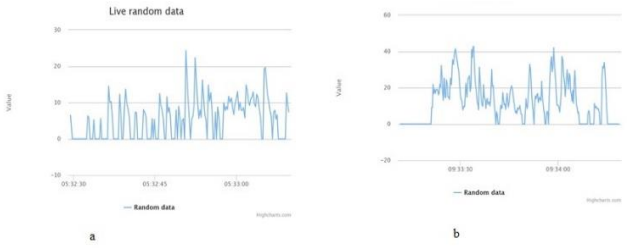

Figure 3 a, b: The sound intensity before after treatment

CT scan after 6 months treatment showed a normal ratio of TMJ elements, the size of the bone parts of the joint and the joint space were normal (fig. 4).

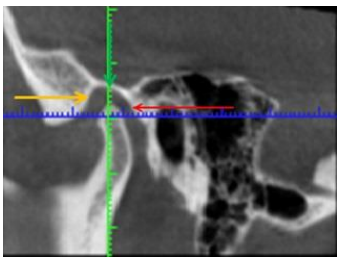

Figure 4: Computer tomography (CT) after 6 months treatment

Data analysis showed a decrease in sound in the dynamics of treatment and normalization of parameters 3 months after treatment.

Discussion

The increase in the number of patients with TMJ pathology can be explained by the improvement of diagnostic and paraclinical methods, particularly due to technical medical research [30-34].

Acute or chronic changes in occlusal ratio (super contact), incomplete restoration of anatomical features, are considered to be one of the fundamental triggers in the pathogenesis dysfunction TMJ, since premature contacts contribute to the forced dated position of the lower jaw and the formation of pathological conditions [35, 36]. Therefore, each patient must be analyzed in a specific way, and the treatment approaches must be adapted to the specific characteristics of the disease.

Malocclusion and occlusal interference are one of the factors in the development of temporomandibular disorders, so occlusal correction is included in the complex treatment of TMJ [37, 38]. Among these factors, mistakes and complications in endodontic interventions, restoration and filling of teeth, which can cause TMJ dysfunction syndrome, should be

taken away. For the TMD diagnosis, various methods of diagnosing (MRI, CT, survey and panoramic radiography, arthrography) are used [39-44]. In many studies, sound recording is included in the diagnostic arsenal in the diagnosis of TMJ dysfunction syndrome [45-50].

The click in the joint usually occurs when there is a disruption in coordination movement between the joint head and the disk. It is characterized by a short sound of greater amplitude than crepitus. Double click occurs when the disc is located at the end of the joint head when the teeth are closed. When opening the mouth, the joint head moves down and forward, overcoming the resistance of the joint disc. At a certain moment when opening the mouth, the disk jumps onto the joint head, the click occurs, and from that moment on, the disk moves along with the joint head. The second click occurs when the disk jumps back to the front position while closing the mouth. As a rule, this occurs closer to the position of the teeth closing.

The click has a larger amplitude (louder) when opening the mouth than that of closing. A click occurs in the process of opening the mouth when the back disc gets thinner, stretches and the lateral and retrocondylar gaments get thinner. The sonogram is characterized by the presence of medium amplitude sound followed by non-specific noise of low amplitude and medium frequency. A number of authors attribute this noise to the roughness of the joint head and disc adhesion. The last click occurs at the end of maximum mouth opening. Since, with the maximum opening of the mouth, stretching and thinning of the lateral and retrocondylar ligaments occur, the click is characterized by a longer noise of a higher frequency. More than 50% of normally functioning joints have this click.

Crepitus is a clinical symptom of structural degenerative changes in the articulating surfaces. An increase in the frequency of noise is associated with arthrosis. The higher is the frequency, the worse is the degree of the affected joint. A typical sonogram shows a long record of high frequency noise.

Assessment of articular sounds is considered a key procedure and should be included as a diagnostic criterion. The analysis of the sound (vibration) frequency allows a more detailed differential diagnosis of the joint tissue state.

Based on the foregoing, the purpose of this study was to develop an auxiliary functional-hardware method for diagnosing sound in patients with TMJ dysfunction syndrome.

The study included 54 patients with TMJ dysfunction syndrome who had previously undergone endodontic dental treatment. The main patient complaints included pain, difficulty or discomfort when biting or chewing, clicking, popping or grinding sound when opening or closing the mouth, ear pain, headache, decreased ability to open or close the mouth. The cause of the pain was abnormal contractions of the masticatory muscles, which stimulated the production of inflammatory substances around the joint. To evaluate the effectiveness of the treatment of patients with temporomandibular joint dysfunction, along with clinical and radiological methods for sound recording, a functional electrosonoraphy was used. The simplicity of the TMJ research method, non-invasiveness allows to record noise using highly sensitive microphones applied to the joint area and to record within 10-15 seconds.

This functional method in electronic form makes it possible to analyze the course of activities used in the treatment dynamics, to record and store in a digital or graphic image. Complex treatment methods of the examined patients included correction of the occlusal height of filled teeth, 10 sessions of magneto-laser therapy in the joint area, muscle relaxant, drug treatment, manual therapy, massage, polystyrene and, if indicated, orthopedic elimination of occlusal disorders. Adequate psychotherapy, elimination of traumatic factors, the use of pharmacotherapeutic agents, physiotherapy, normalization of functioning associated with occlusive factors, made it possible to rehabilitate patients with impaired TMJ function. Data analysis showed a decrease in sound in the dynamics of treatment.

When planning therapeutic measures for TMJ dysfunctions, it is necessary to carry out a clinical and radiological assessment, orthopantomography, CT scan, functional research methods (electrosonography), as well as eliminate the causes preceding its development (occlusal jaw ratios), which will significantly increase the possibility to diagnose and treat dysfunction of the temporomandibular joint.

Conclusion

The syndrome of pain dysfunction of the temporomandibular joint is amenable to effective conservative treatment. Proposed modified portable device for determining TMJ sounds provides more accurate auscultation and analysis of sounds in TMJ dysfunctions, to record and store sounds in a digital or graphic image, makes it possible to analyze the dynamics of treatment.

Conflicts of interest and financial disclosures: The author declares that he has no conflict of interest. None of the authors have relevant financial relations with a commercial interest.

Funding: The work was not funded.

Ethical approval: The study was reviewed and approved by the local Ethical Committee (Approval number N12, Date 17.11.19) and in accordance with those of the World Medical Association and the Helsinki Declaration.

Informed consent: Patients were informed verbally and in writing about the study and gave written informed consent.

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ՀՈԴԱՅԻՆ ՁԱՅՆԻ ԳՐԱՆՑՈՒՄ ՔՍԾ-Ի ԴԻՍՖՈՒՆԿՑԻԱՆԵՐԻ ՀԱՄԱԽՏԱՆԻՇՈՎ ՀԻՎԱՆԴՆԵՐԻ ՄՈՏ՝ ԿԱՊՎԱԾ ՕԿՅՈՒԶԻԱՅԻ ԽԱՆԳԱՐՈՒՄՆԵՐԻ ՀԵՏ

Ժաննա Խաչատրյան [1], Սոնա Համբարձումյան [2], Լյուդմիլա Տատինցյան [2], Մինաս Պողոսյան [2], Արսեն Կուպելյան [3], Վարդան Գևորգյան [4], Վալերի Տատինսյան [5]

[1] Բժիշկ, «Փայլ դենտ» ատամնաբուժական կլինիկա, Երևան, Հայաստան
[2] Դասախոս, Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի թերապևտիկ ստոմատոլոգիայի ամբիոն, Հայաստան
[3] Դասախոս, Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի վիրաբուժական ստոմատոլոգիայի և դիմածնոտային վիրաբուժության ամբիոն, Հայաստան
[4] Դասախոս, Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի մանկական ստոմատոլոգիայի և օրթոդոնտիայի ամբիոն
[5] Պրոֆեսոր, Երևանի Մ. Հերացու անվան պետական բժշկական համալսարանի թերապևտիկ ստոմատոլոգիայի ամբիոն, Հայաստան

Ամփոփում

Հետազոտության նպատակն է մշակել ֆունկցիոնալ ապարատային մեթոդ TMJ-ի դիսֆունկցիայի համախտանիշում հնչյունների որոշման և ձայնագրման համար:

Նյութ և մեթոդներ: Հետազոտությունը ներառում էր 54 հիվանդ՝ ՔՍԾ-ի դիսֆունկցիայի համախտանիշով, ովքեր նախկինում անցել էին էնդոդոնտիկ ատամնաբուժական բուժում: Բոլոր հիվանդներն ունեցել են օկյուզիայի խցանման խանգարումներ ատամների էնդոդոնտիկ բուժումից և վերականգնումից հետո սխալների պատճառով: ՔՍԾ-ի ախտորոշելու համար օգտագործվել է CT սկանավորում: TMJ-ի ձայնի ախտորոշման օպտիմալացման համար օգտագործվել է ՔՍԾ-ի ձայնի որոշման փոփոխված շարժական սարքը և ստացված տվյալների վերլուծության և մշակման համակարգչային ծրագիր: Բոլոր հիվանդներին արվել է լիարժեք էնդոդոնտիկ բուժում և պսակի հատվածի վերականգնում՝ հաշվի առնելով անատոմիական առանձնահատկությունները: Բարդ թերապիան ներառում էր նաև մագնիսական լազերային թերապիա:

Արդյունքները: ՔՍԾ-ի դիսֆունկցիայի համախտանիշով ախտորոշված հիվանդների համալիր բուժման դինամիկան ցույց է տվել, որ բուժումից հետո կլինիկական ախտանշանները աստիճանաբար նվազել են և անհետացել բուժման ավարտին: Բուժումից մեկ տարի անց CT սկանավորումը ցույց տվեց ՔՍԾ-ի տարրերի նորմալ հարաբերակցությունը:

Բուժումից առաջ և բարդ բուժումից 4 ամիս անց հոդային ձայնի հնչյունների գրանցումը ցույց է տվել նվազում և լրիվ անհետացում:

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DOI: 10.58240/1829006X-2023.19.1-92

Եզրակացություններ: ՔՍԾ -ի դիսֆունկցիայի համախտանիշը ենթակա է արդյունավետ պահպանողական բուժման: Առաջարկվող փոփոխված շարժական սարքը TMJ ձայները որոշելու համար ապահովում է ՔՍԾ-ի դիսֆունկցիայի համախտանիշի ձայների ավելի ճշգրիտ լսում և վերլուծություն, ձայները ձայնագրելու և պահելու համար թվային կամ գրաֆիկական պատկերով, հնարավոր է դարձնում վերլուծել բուժման դինամիկան:

РЕГИСТРАЦИЯ СУСТАВНОГО ЗВУКА У БОЛЬНЫХ С СИНДРОМОМ ДИСФУНКЦИЙ ВНЧС, АССОЦИИРОВАННЫМ С НАРУШЕНИЕМ ОККЛЮЗИИ

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Абстракт

Цель исследования — разработка функционально-аппаратного метода определения и регистрации звуков при синдроме дисфункции ВНЧС.

Материал и методы: В исследование включены 54 пациента с синдромом височно-нижнечелюстной дисфункции, которым ранее проводилось эндодонтическое стоматологическое лечение. У всех пациентов имелись нарушения прикуса из-за ошибок при восстановлении пломбировочного материала. Для диагностики ВНЧС использовали компьютерную томографию. Для оптимизации диагностики звука ВНЧС использовали модифицированный портативный прибор для определения звука ВНЧС и компьютерную программу для анализа и обработки полученных данных. Всем пациентам было проведено полноценное эндодонтическое лечение и восстановление коронковой части с учетом анатомических особенностей. .В комплекс терапии также входили терапия и магнитолазеротерапия.

Результаты: Динамика комплексного лечения больных с диагнозом синдром дисфункции ВНЧС показала, что после лечения клинические симптомы постепенно уменьшались и исчезали к концу лечения. КТ через год после лечения показала нормальное соотношение элементов ВНЧС. Регистрация звуков до лечения и после комплексного лечения показала их уменьшение и полное исчезновение через 4 мес.

Выводы: Синдром дисфункции ВНЧС поддается эффективному консервативному лечению. Предложенный модифицированный портативный прибор для определения звуков ВНЧС обеспечивает более точную аускультацию и анализ звуков при дисфункциях синдрома ВНЧС, запись и сохранение звуков в цифровом или графическом изображении, дает возможность анализировать динамику лечения.

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