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Differential diagnosis of temporomandibular disorders — a review of the literature

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Abstract: Pain in the masticatory muscles or temporomandibular joints may in some cases be a symptom of other afflictions occurring in this region. The aim of the study was to present the differential diagnosis of temporomandibular disorders (TMD) and other diseases in the craniofacial area, based on review of the literature. Using the key words: "differential diagnosis of TMD", "pain of non-dental origin" and "chronic orofacial pain", PUBMED and Scopus databases were systematically searched for articles in English from 2005 to 2020. Additionally, the PUBMED database was supplementarily reviewed using the keywords "Lyme disease orofacial symptoms" for the English-language articles published in the years 1996–2020. Out of 445 publications from PUBMED and Scopus databases as well as other sources, 57 articles describing the pathogenesis and characteristic symptoms of diseases that may cause pain similar to that occurring in TMD as well as diagnostic methods used in differential diagnosis of TMD were selected for analysis. Dental and jawbones-related conditions, ear and maxillary sinus diseases, as well as ailments of neuropathic and vascular origin, were taken into account. Neoplastic processes taking place in this region and less often occurring diseases caused by viruses, bacteria and parasites were also described. Conclusions. Correct diagnosis of temporomandibular disorders is based on medical history and thorough physical examination, as well as results of additional tests. Pain localized in the head and neck structures may have diverse, sometimes complex aetiology, and may require multidisciplinary treatment. Observation of the patient's behaviour and — in selected cases — the results of additional laboratory tests, also play a significant role.

Keywords: differential diagnosis of TMD, pain of non-dental origin, chronic orofacial pain, Lyme disease orofacial symptoms.

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Introduction

The diagnosis of a disease is the result of meticulously taken medical history, correctly conducted clinical examination and observation of the patient's behaviour, as well as the selection of appropriate laboratory tests and analysis of the results of additional tests [1]. Temporomandibular disorders (TMD) come in several different forms, and pain in the masticatory muscles and temporomandibular joints can result from many other causes or diseases occurring in the craniofacial area. The hallmarks of a particular disease are not always readily available. Incorrect diagnosis of a disease entails an inappropriate therapeutic regimen and, consequently, failure of medical treatment [2].

More and more modern diagnostic equipment, operating on the basis of modern materials and digital technologies, is introduced into the daily practice of a doctor, but the doctor's specialist knowledge, "pathophysiological thinking" and practical experience are still extremely valuable [3]. The differential diagnosis between diseases presenting similar symptoms often requires the analysis of specific risk factors for these diseases, the location of individual signs and symptoms, their nature, as well as symmetry or lack thereof in the scope of other analyzed ailments [1–4].

Prosthetic rehabilitation of the masticatory system is aimed at eliminating pain, as well as restoring harmonious cooperation of all components of this system. TMD symptoms are very diverse, and within these dysfunctions alone, the diagnosis may raise many doubts. The characteristic TMD symptoms are pain or tenderness in the masticatory muscles (acute or chronic), pain in the area of temporomandibular joints, limited jaw opening, lack of symmetry in mandibular movements combined with an abnormal path of jaw opening, acoustic symptoms (clicking or crepitations) occurring in the joints, as well as pathological changes in the intracapsular structures, revealed in magnetic resonance (MR) and ultrasound imaging [4–6].

TMD is the third most common disease, preceded by caries and periodontal diseases, causing pain in the craniofacial area [1]. The multitude and variety of pain symptoms reported by patients suffering from this disease sometimes creates a big diagnostic and therapeutic problem for the attending physician. At the same time, pain localized in the head and neck structures may have diverse, sometimes complex aetiology, and thus, clinical management may require additional diagnostic tests and, consequently, multidisciplinary treatment, often beyond the competence of dentists [7].

Aim of the study

The aim of the study is to review the literature on the differential diagnosis of TMD and other diseases manifested by orofacial pain.

Materials and Methods

In order to analyse the literature, the following keywords were used: differential diagnosis of TMD, chronic orofacial pain and pain of non-dental origin. PUBMED and Scopus databases, as well as other sources, like internet pages and academical bases were systematically searched using these phrases. The inclusion criteria were: original and review papers in English published from 2005 to 2020. Additionally, the PUBMED database was supplementarily reviewed using the keywords: Lyme disease orofacial symptoms. The articles in English, published from 1996 to 2020, were included in the analysis. The search was conducted by two independent authors. Reviews, research papers, RCTs and case reports on the adult population were taken into account. The search focused on the comparison of clinical symptoms and methods used in differential diagnosis of TMD. The exclusion criteria included articles focusing only on the management of TMD and other diseases with similar head and neck symptoms.

Results

As a result of the literature review, a total of 445 articles meeting the keyword criteria were obtained. Out of 247 articles from the PUBMED database, 184 papers from the Scopus database and 14 records identified through other sources, after removing duplicates (n = 162), 283 publications meeting the inclusion criteria were selected for further proceeding. The analysis of titles and abstracts allowed the preliminary selection of 90 articles. After the evaluation of full texts, using the given criteria, it was decided to include 57 publications presenting relevant information on the chosen topic (Fig. 1). The obtained results were presented by describing the characteristic clinical symptoms and methods for diagnosing and differentiating diseases that mimic TMD, depending on their aetiology.

Discussion

Most of the pain in the craniofacial area is of dental origin. Pain can be present in many common diseases, ranging from dentine hypersensitivity, through inflammation of the pulp, periapical tissues and advanced periodontitis, to injuries of the teeth and surrounding tissues. The attention should also be paid to the painful eruption of wisdom teeth, which leads to symptoms similar to TMD. Most of these cases do not pose diagnostic difficulties for the dentist. At the same time, one should remember about the possibility of less common diseases that cause pain in this region, and thus be able to distinguish between the pain of dental origin and that not related to teeth, to avoid unnecessary, sometimes irreversible, restorative or surgical treatment [8–10].

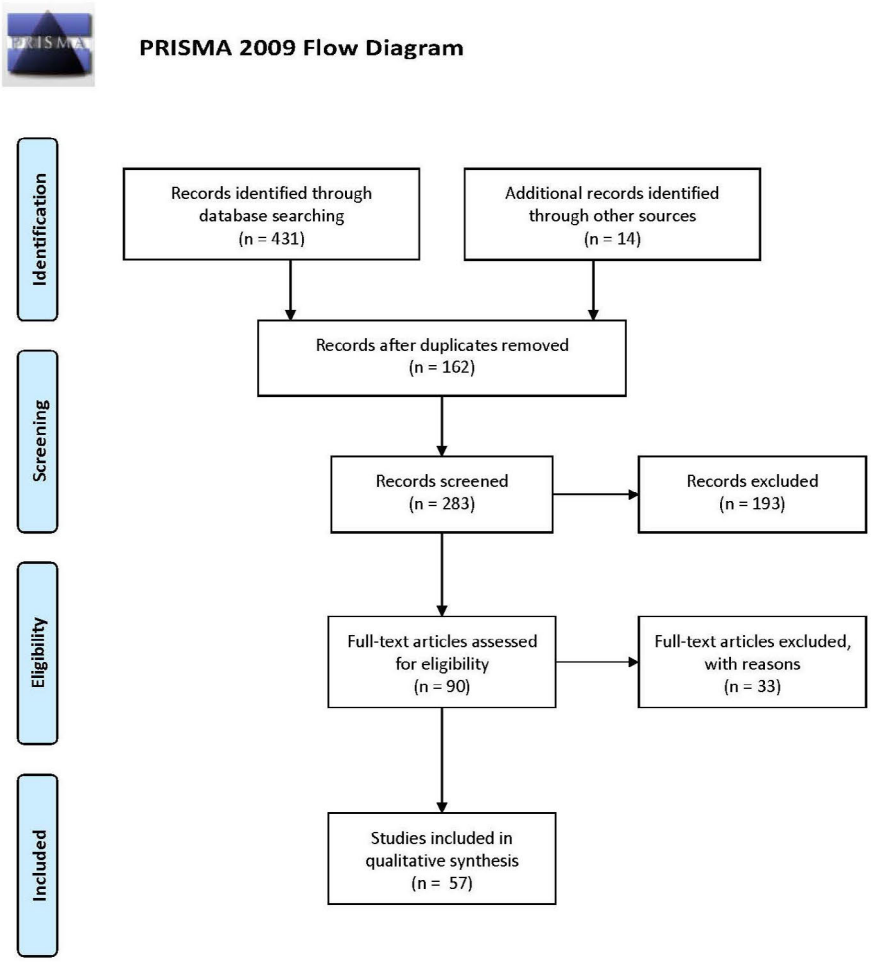

Fig. 1. The comparison between PSS-10 and the sex. p — Mann–Whitney test, p = 0.041.

Pain in the jaws region can be caused by alveolitis following tooth extraction or other bone pathologies such as osteomyelitis, osteonecrosis or rare pathologies, such as Eagle syndrome or Pterygoid Hamulus Syndrome [11–13]. The most common, non-odontogenic diseases that give symptoms mimicking TMD are diseases of the ear and maxillary sinuses [14, 15]. Symptoms of similar location can also be related to the salivary gland diseases, especially in the case of salivary duct obstruction [16].

Chronic pain in the head and neck area, as one of the TMD predominant symptoms, is often the cause of reduced quality of life and psychoemotional problems in many patients, which is rarely observed in the case of dental pain [8]. The differential diagnosis of neuropathic diseases leading to this kind of pain should primarily include

secondary trigeminal neuralgia, followed by glossopharyngeal neuralgia, Guillain–Barré Syndrome or Burning Mouth Syndrome [17–19]. Cranial nerves can also lead to pain symptoms after a viral infection (Postherpetic Neuralgia), as a result of an injury or iatrogenic effect (Trigeminal Neuropathic Pain), or be rather psychosomatic, as in the case of Chronic Idiopathic Facial Pain — CIFP [9].

Headaches of vascular etiology constitute a separate group of TMD-resembling diseases. These include tension-type headaches, migraine, and temporal arteritis [20]. The trigeminal autonomic cephalalgias (TACs), including such diseases as paroxysmal hemicrania (PH), cluster headaches (CH) or short-lasting unilateral neuralgiform attacks (SUNA/SUNCT), are of similar origin [21].

Headache and neck pain can also be induced by many other causes. First of all, primary and secondary neoplastic processes taking place in this area should be mentioned here, as well as diseases caused by bacteria, such as tetanus and Lyme disease, and even rare cases of parasite invasions, causing, for example, cysticercosis in the masticatory muscles [22–25].

The basis of the correct TMD diagnosis is thoroughly taken history and detailed physical examination, supplemented with the results of additional tests [1]. The patient's medical history and clinical examination should take into account standardized diagnostic criteria for TMD (DC/TMD). DC/TMD, as a continuation of the RDC/TMD, is a two-axis diagnostic system that has undergone rigorous scientific research and is used to diagnose the most common TMDs in clinical and research settings [6, 26]. The new DC/TMD taxonomy extension considers less common but clinically significant TMDs [27]. Axis I of diagnostic criteria includes pain history and clinical symptoms in the temporomandibular and masticatory areas. The TMD Pain Screener is a six-component pain assessment tool, and the Symptom Questionnaire (DC/TMD SQ) provides the symptom history necessary to make a diagnosis.

Axis II consists of questionnaires that provide an assessment of psychosocial and behavioural factors that may affect the course of TMD. The Patient Health Questionnaire (PHQ-4) is used to detect "mental stress" caused by anxiety or depression. The Graded Chronic Pain Scale (GCPS) is a tool for assessing pain intensity and related disability. The third instrument is head, jaw and body pain assessment that allows the patient to report the location of all pain symptoms graphically. The Jaw Functional Limitation Scale form (JFLS) assesses restrictions on chewing, jaw mobility, and verbal and emotional expression. The Oral Behaviours Checklist (OBC) is used to assess the frequency of parafunctional behaviours. In the new Axis II, PHQ-9 and GAD-7 (Generalized Anxiety Disorder) are also used to detect symptoms of depression and anxiety and PHQ-15 serves to assess concomitant somatic symptoms. Axis I criteria for the most common intracapsular TMDs are appropriate for screening purposes only. Final diagnosis requires computed tomography (CT) or MRI [6, 26].

In the future it is planned to develop Axis III, which, with the help of genetics and neurosciences, can improve diagnostics thanks to the use of biomarkers detecting pathobiological processes underlying TMD [27].

Additional tests are necessary to confirm the correct diagnosis; they are a valuable help in planning effective treatment and also allow for the assessment of its results [8]. Among imaging methods, periapical and bite-wing x-rays are sufficient to assess caries and the periapical area of the teeth. Orthopantomograms are used to detect and initially assess pathological changes in the jaw bones. The function of the temporomandibular joint in real-time is well illustrated by ultrasound imaging. MRI is the best diagnostic tool to assess changes in the head and neck's soft and hard tissues [1]. Blood tests, such as complete blood count, iron and glucose levels, erythrocyte sedimentation rate (ESR) or immunological tests in the case of suspected vascular or neuropathic diseases, can also be indicated [8].

It should be kept in mind that many diseases that cause long-term pain in the head and neck area may require a multidisciplinary approach. If depressive or anxiety disorders are suspected, there is an indication for psychological or psychiatric consultation [6, 8].

Below is a brief description of some of the conditions that should be taken into account in the first line of differential diagnosis in TMD, as well as a few less common diseases of similar presentation that a dentist should rule out before making a final diagnosis.

Ear diseases

Otitis media and externa cause the so-called primary ear pain that comes directly from the ear structures, as opposed to secondary pain, originating outside the ear. The etiology of the primary ear pain is difficult to determine due to the complex sensory innervation of the ear (nerves V, VII, IX, X, C2 and C3). Irritation of any of these nerves can cause ear pain [28]. The location of pain in this case overlaps with TMD pain in the temporomandibular joints.

Otitis is usually diagnosed during a routine examination of ear, nose, and throat (ENT). Symptoms such as erythema and bulging of the tympanic membrane, otorrhea and vertigo suggest acute otitis media. The pain is usually continuous and increases gradually [29]. Eustachian tube dysfunction is also a common cause of primary ear pain, resulting from pressure dysregulation in the middle ear. The otoscopic examination shows the tympanic membrane retraction [30]. Patients may experience earache when diving or flying [31]. These symptoms can be experienced as "ear clogging", sudden hearing loss or a feeling of obstruction in the throat and should be differentiated from ENT symptoms of TMD. A completely different clinical picture is

seen in otitis externa ("swimmer's ear"), which manifests as pain, redness and swelling along the external ear canal. Pain accompanying visible vesicles in the ear canal or outer ear may indicate ear shingles (Ramsay Hunt syndrome) [28].

Maxillary sinusitis

Acute maxillary sinusitis is manifested by constant headache, most often in the zygomatic or temporal region, mimicking TMD. Pain radiates to the upper molars and forehead, and purulent discharge appears in the nasal cavity [32]. In about 50% of cases, it is accompanied by fever, nasal obstruction and a loss of smell. The symptoms usually appear as a complication of upper respiratory tract infections [33]. Dull pain occurs on one or both sides, mainly in the upper masseter attachment area, and may vary in intensity. In chronic inflammation, pain is absent or may be mild. The characteristic symptom that can distinguish sinusitis from TMD is increased pain when the head is tilted forward and, in the case of chronic inflammation, fetor ex ore [34].

Diagnosis is made primarily on the basis of history and clinical symptoms. In addition, X-rays in acute inflammation show the air-fluid level in the maxillary sinus, in the case of chronic inflammation thickening of the sinus mucosa is observed, but in 30% of cases, CT gives a falsely positive image. In order to finally confirm the diagnosis, an endoscopic examination is performed, which shows congestion of the nasal and sinus mucosa and the presence of purulent discharge [33].

Trigeminal neuralgia

In the classification of headaches according to the International Head Society (2013), trigeminal neuralgia (TN) is classified into three forms: classic, with morphological changes in the root of the V nerve due to compression by a blood vessel; secondary, where neuralgia occurs due to another disease; and idiopathic with unknown disease ground. The classic form is often accompanied by contractions of the facial muscles (*tic douloureux*), as well as autonomic symptoms such as lacrimation, increased salivation or facial redness. A characteristic feature is the absence of discomfort during sleep [35].

Contrary to primary, spontaneous neuralgia, the secondary form is characterized by pain very similar to that occurring in TMD. It builds up gradually and lasts continuously for many hours. High ambient temperature aggravates symptoms. This type of neuralgia can be a symptom of many diseases, ranging from pulpitis, otitis and maxillary sinusitis to tumors of the maxillary and ethmoid sinuses or the cerebellopontine angle (e.g. acoustic neuroma). Sometimes it can be one of the symptoms of mercury, alcohol or nicotine poisoning [17].

Both common features and differences in pain characteristics should be considered in the differentiation of secondary TN and TMD. Similar features include the possibility of unilateral pain localization, pain radiating to the surrounding structures, intensification of pain during the activity of the facial muscles and chewing, as well as frequent occurrence of ENT symptoms, such as hearing loss or ear pain [17]. Moreover, the chronic nature of pain leads to deterioration of patients' quality of life and — in both cases — may contribute to the development of depression and anxiety disorders [36].

The nature of pain is one of the most important differences. Neuralgia does not occur during sleep, while dysfunctional pain may still be felt. Moreover, the location of pain in neuralgia is unilateral in 97%, while myalgia occurs more frequently on both sides [17]. In addition, neuralgia is often accompanied by muscle tics, facial redness or lacrimation, which is not observed in patients with masticatory dysfunction. On the other side, the symptom of a "square face" can be observed as a result of masseter hypertrophy due to their excessive activity [37].

V nerve neuralgia most often affects people in the fifth or sixth decade of life, and TMD most often affects those in the third and fourth decade. The appearance of similar symptoms in young people should prompt the doctor to perform additional tests, particularly MRI of the head, to exclude the coexistence of other diseases, such as multiple sclerosis or tumors of the posterior cranial fossa. TN occurs in 2–4% of patients with multiple sclerosis and is often its first symptom [38].

Acoustic neuroma

About 6 to 16% of patients with trigeminal neuralgia symptoms also have intracranial tumours, the most common of which is acoustic neuroma. The most significant symptoms reported by patients are tinnitus, headache and dizziness, gradual loss of hearing, often associated with loss of balance, as well as pain and numbness of the face. The above symptoms are very similar to the ENT symptoms of TMD. Soreness in the surrounding muscles of the head and neck is also observed. In such cases, MRI turns out to be the most effective tool for the differentiation between these diseases [22].

Trigeminal neuropathic pain

Trigeminal neuropathic pain is one of the varieties of chronic facial pain resulting from damage to one or more branches of the trigeminal nerve, most often due to an injury to the face or an iatrogenic effect (a complication after anaesthesia). Ailments located in the area supplied by the damaged nerve are described as constant, burning, sometimes with short attacks of acute, intermittent pain. Tingling and numbness in the area are also often observed, as well as sensory disturbances or abnormal pain

sensation (allodynia, hyperalgesia). In this case, palpation-induced pain in the cheek or temple area may be misdiagnosed as masticatory tenderness associated with TMD [39].

Trigeminal neuropathies are often associated with connective tissue diseases, such as scleroderma, Sjögren's syndrome, rheumatoid arthritis, and dermatomyositis. The mechanism is not well understood, but it is suspected that the inflammation of the surrounding vessels, which intensifies in the course of the diseases mentioned above, may be the underlying cause of these ailments. Diagnosis is based on history and clinical symptoms [40].

Glossopharyngeal neuralgia

IX nerve neuralgia is a rare disease that most often affects women over 50. The classical form is characterized by attacks of severe, recurrent, stabbing pain in the ear, at the root of the tongue, around the tonsils, or behind the angle of the mandible, usually unilaterally. Coughing, swallowing or even talking can be factors that trigger pain episodes. This type of discomfort can mimic the pain worsening with the mandible movement in TMD. In a secondary form, additional symptoms of primary ailment may appear between attacks [19].

Migraine

Migraine is a chronic headache, occurring in about 11% of adults, more often in women, usually unilaterally in the frontal and temporal areas [20]. The location and nature of pain is a common cause of diagnostic confusion with TMD headache. Episodes of severe throbbing pain last from 4 hours to 3 days and often exclude the patient from daily functioning [33]. Characteristic accompanying symptoms that may help rule out other conditions, such as TMD, are light and sound discomfort, nausea and vomiting. Pain often gets worse when climbing stairs. In about 15% of cases, ailments are preceded by the so-called aura lasting for 5–20 minutes, consisting of specific symptoms that precede pain, with visual disturbances being the most common [41].

Migraines are often exacerbated in patients diagnosed with TMD [42]. Significant variations in the nature of pain were also observed in women undergoing hormone treatment. Sleep relieves or temporarily alleviates the symptoms [43].

Tension-type headaches

Tension-type headaches are usually episodic, bilateral, moderate ailments of pressure or cramp nature, lasting from 30 minutes to 7 days. They often accompany TMD. Patients typically describe the pain as "pressing on the head like a hoop" [20]. Episodic

form of pain occurs in about 42% of the adult population, making tension-type headaches the most common form of all headaches. There are no accompanying symptoms such as nausea and vomiting, which distinguishes this type of pain from a migraine. In the chronic form that is characterized by more than 15 attacks per month, excessive sensitivity to sound or light might occur. Routine physical activity usually does not exacerbate the symptoms and sometimes even alleviates them. The most common triggering factors are lack of sleep, excessive mental tension or inadequate nutrition [44]. The chronic form can be often misdiagnosed as a TMD-accompanying symptom [45].

Trigeminal Autonomic Cephalalgias

This rare group of pain symptoms includes paroxysmal hemicrania, cluster headaches and SUNCT (short-lasting unilateral neuralgiform headache attacks with conjunctival injection and tearing) [21]. All these disease entities are characterized by the simultaneous occurrence of a short-term, unilateral attack of severe pain in the area supplied by the first (very rarely, the second) branch of the trigeminal nerve, as well as specific autonomic symptoms that facilitate diagnosis [20]. Pain episodes appear many times a day, most often in the orbital area, and last from 10 seconds to more than 10 minutes. The most common accompanying symptoms are lacrimation, conjunctivitis, eyelid oedema or ptosis, nasal congestion and discharge, as well as restlessness or agitation [46].

Cluster headache attacks often interrupt sleep like an "alarm clock" [8]. They are six times more common in men, most often in their third to fifth decade of life, and can be triggered by alcohol consumption or smoking. In SUNCT, an attack can be triggered by chewing and eating acidic foods. It should be differentiated from the pain associated with TMD, which occurs during mandibular movements [47].

Temporal arteritis

Temporal arteritis usually occurs in women over the age of 50, and it is characterized by continuous, unilateral or bilateral, often throbbing, headache in the temporal region. It may mimic pain of the anterior part of temporal muscle. Pain symptoms are accompanied by swelling of the temporal area, resulting from the bulging of the thickened, nodular external temporal artery, and increase with pressure. Temporal arteritis is often associated with visual or sensory disturbances, weight loss or rheumatic polymyalgia [8]. One of the symptoms that may mimic TMD is mandibular claudication, i.e. fatigue and chewing soreness in the masticatory muscles associated with weakness due to muscle ischemia. A simple "chewing gum test" is helpful in differentiating temporal arteritis from TMD, which involves having the patient chew

gum for 2–3 minutes. In patients with temporal arteritis, the feeling of pain and fatigue in the masticatory muscles appears after such a short time [48].

Early diagnosis of the disease and implementation of treatment with high doses of steroids can prevent the most dangerous complication, which is early vision loss. The final diagnosis is confirmed only after the results of ESR test and the temporal artery biopsy are obtained [9].

Eagle's syndrome

Eagle's syndrome is a set of symptoms described by Eagle in 1937, including two forms of the condition. The classic form occurs in about 4% of the population and consists in the elongation of the styloid process. It compresses the nerves and blood vessels near the jugular foramen and opening of the carotid canal, such as the maxillary and internal carotid arteries, the internal jugular vein, the glossopharyngeal and vagus nerves, as well as the branches of the trigeminal and facial nerves. The most common symptoms include prolonged pain around the ear and the temporomandibular joint, headache, dizziness, and tinnitus. There is also pain and restriction of rotation of the head towards the affected side. Abnormalities in bone development are believed to be the leading cause of the disease [49].

Although Eagle's syndrome's clinical picture resembles TMD (ENT symptoms, pain in the posterior belly of the digastric muscle), ultrasound and panoramic imaging generally helps differentiate between these two conditions. However, MRI and additionally magnetic resonance angiography (MRA) are recommended to prevent damage to the surrounding structures in the case of surgical treatment, as conservative management is often ineffective [11].

Pterygoid Hamulus Syndrome

The term Pterygoid Hamulus Syndrome (PHS) is used to describe the palate and throat pain radiating to the ear and temples, caused by an elongation of the sphenoid bone's hamulus called the pterygoid hamulus. This rare condition is usually misdiagnosed as TMD. Patients complain of pain and difficulty when swallowing. Intraoral examination reveals a hard swelling of the soft palate in the maxillary tuberosity area with pronounced mucosal blanching and tenderness upon touch [12]. The underlying cause of these ailments is the pressure of the elongated pterygoid hamulus on adjacent structures such as the palatal, glossopharyngeal and facial nerves, which can mimic neuralgia. The tensor veli palatini muscle's function is also disrupted, and its compressed tendon reacts with inflammation. Diagnosis is based on clinical symptoms and cone beam computed tomography (CBCT) [50].

Guillain–Barré Syndrome

Guillain–Barré Syndrome (GBS) is a rare disease of the peripheral nerves and nerve roots. It is believed to be caused by an abnormal immune response to infection that damages peripheral nerves. GBS incidence may increase during outbreaks of infectious diseases, as it did during the Zika virus outbreak in 2013 or the current Sars-CoV-2 epidemic [51]. The clinical picture of this disease is dominated by the loss of sensation and muscle weakness in different body areas, but there are several distinct clinical variants. One of them is limited to the cranial nerves, mainly the facial nerve, and is manifested by bilateral facial paralysis with paresthesia and weakening of reflexes [52]. Another is the Miller–Fisher syndrome, where one of the symptoms is ophthalmoplegia — a reduced ocular mobility due to paralysis of the oculomotor nerve. These symptoms are often accompanied by pain of a muscular, radicular or neuropathic nature, mimicking TMD [18].

GBS diagnosis is based on history (approximately 2 out of 3 patients report symptoms of infection within six weeks preceding the disease's onset) and on a neurological, electrophysiological and cerebrospinal fluid (CSF) examination [53].

Lyme disease

Lyme disease (Lyme borreliosis, LB) is an anthropozoonosis caused by bacteria of the *Borrelia burgdorferi sensu lato* complex, transmitted by ticks, mainly of the species *Ixodes ricinu*s in Europe. It can attack various tissues, such as the skin, the muscles, the joints and the nervous system [54]. A review of the dental literature does not reveal many references to this disease. However, the clinical symptoms may include facial and dental pain, facial nerve paralysis, headache, as well as temporomandibular joint and masticatory muscle pain. TMD-like symptoms usually occur in the early stages of Lyme disease. The presence of the above symptoms prompts patients to seek help primarily in a dentist's office [24].

Arthritis occurs 4 days to 2 years (6 months on average) from the onset of erythema migrans (EM). The first joint affected by pain is often near an EM or tick bite. Sometimes small joints are also affected, such as the temporomandibular joints (the fourth most commonly affected joint in Lyme disease). Arthroscopy of the temporomandibular joint of a patient infected with Lyme disease reveals synovitis and swelling, which may be manifested by occlusion disorders [55]. The duration of joint pain periods increases, while painless periods become shorter and shorter. The disorder can become chronic or intermittent, with pain episodes lasting weeks to months, and then symptoms may resolve. The intensity of the attacks decreases over time. Changes in the muscular system include pain, weakness and inflammation in the masticatory muscles [56]. The most common symptom in the

nervous system is a headache. Cranial nerves, especially the facial nerve in 80% (Bell's palsy), and nerves III, IV and VI, may be paralyzed. Optic neuritis can also occur [57].

Tetanus

Tetanus is an acute infectious disease of the nervous system, caused by infection with *Clostridium tetani* spores in people without protective circulating antibodies. Gram-positive *C. tetani* are strict anaerobes, unlike their spores, which tolerate air, extreme temperatures, and commonly used disinfectants. They enter the body most often from the soil through contamination of wounds and may undergo anaerobic transformation [58].

The incubation period is 3–21 days. Tetanus toxin is one of the most potent toxins identified, with a median lethal dose for humans below 2.5 ng/kg, and it is transported to the central nervous system (CNS). The signs and symptoms of tetanus result from overstimulation of motor neurons, causing hypertonia and severe skeletal muscle spasm. There are four types of clinically distinguished tetanus: cephalic, local, generalized and neonatal [59]. Cephalic tetanus is manifested by trismus and paralysis of one or more cranial nerves (most often the facial nerve) and accounts for only 0.9–3.0% of all tetanus cases. Two-thirds of head tetanus cases develop generalized tetanus, with a 15–30% mortality rate [60]. Initial symptoms include trismus, which may mimic the limitation of jaw opening occurring in TMD. *Risus sardonicus* ("devil smile") also appears frequently, as a result of spasm of the facial muscles with the corners of the mouth being pulled outwards [59]. There is also stiffness in the neck muscles. In the early stages, the pharynx and larynx muscles' involvement results in impaired airway and difficulty swallowing. In the generalized form, tonic stiffness and painful muscle spasms appear in various body regions. Opisthotonus — spasms of the back extensor muscles or spasticity of the abdominal muscles — may be a symptom differentiating tetanus from TMD [61].

The diagnosis is based on history (previous skin damage — trauma, surgical wounds, puncture) and the clinical picture. Wound culture identifies *Clostridium tetani*. There are no typical changes in laboratory values. Electromyography shows continuous, unstoppable muscle activity [59].

Masticatory muscle cysticercosis

Cysticercosis is a parasitic disease caused by *Taenia solium* larvae. The intermediate host is a pig, and the infection can spread to humans through consumption of contaminated food or water. The disease most often affects the subcutaneous tissues and muscles. There have been rare reports of cysticercosis in the masseter, temporal and

lateral pterygoid muscles, both as part of disseminated disease and in an isolated form. Characteristic symptoms in the case of temporal muscle involvement are pain and swelling in the temples, and difficulty in chewing and speaking; while in the case of the masseter muscles — pain and swelling in the mandibular are, as well as limited jaw opening [62, 63]. These symptoms can be misdiagnosed as a muscular disorder in TMD.

It is worth noting that the pain during the muscles' palpation does not coincide with the course of the muscle fibres. An interesting clinical picture is shown by cysticercosis of the lateral pterygoid muscle, where apart from limiting the jaw opening, there is also a reduced range of lateral movement in the direction opposite to the affected muscle. It may result in the misdiagnosis of the TMJ disc displacement without reduction and cause the initiation of inappropriate treatment, which exposes the patient to loss of health and even life [23]. The final diagnosis is based on high-resolution ultrasound, fine needle biopsy and MRI [64].

Conclusions

The basis for the correct diagnosis of the masticatory system's dysfunction is careful history and thorough physical examination, supplemented with additional tests' results. TMD symptoms are very diverse, which creates a big diagnostic and therapeutic problem for the attending physician. At the same time, pain localized in the head and neck structures may have a diverse, sometimes complex etiology, and thus may require multidisciplinary treatment, often beyond the competence of dentists.

Conflict of interest

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