

TEMPOROMANDIBULAR DISORDERS – THE ROLE OF NEUROMUSCULAR DENTISTRY

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Summary

Masticatory system function disorders, known as temporomandibular disorders (TMD) represent frequently encountered problem in daily practice. Clinicians generally agree that psychosocial factors (stress), trauma (macrotrauma - any sudden force to the joint resulting in structural alteration, or microtrauma - functional overloading associated with muscular hyperactivity (bruxism) or occlusal instability), and occlusal conditions have the important role in the onset of TMD.

Neuromuscular dentistry is modern approach in diagnosis and treatment of TMD. It objectively evaluates the complex relationship between teeth, masticatory muscles, temporomandibular joints and cranial nerves in order to achieve an occlusion that is based on the optimal relationship between the mandible and the skull – a neuromuscular occlusion. Neuromuscular dentistry uses computerized instrumentation to measure the patient's jaw movements via Computerized Mandibular Scanning (CMS) or Jaw Motion Analysis (JMA), muscle activity via electromyography (EMG) and temporomandibular joint sounds via Electro-Sonography (ESG) or Joint Vibration Analysis (JVA).

The fact is, however, that to date there is still no sufficient number of randomized double-blind clinical studies that could objectively help in choosing the appropriate method of diagnosis and treatment of TMD, and that in the future those studies certainly might contribute to resolving the enigma of temporomandibular disorders.

Key words: temporomandibular disorders; neuromuscular dentistry; masticatory muscles.

INTRODUCTION

All functions of masticatory system depend on the state and the interaction of its basic components: masticatory muscles, temporomandibular joints and teeth. Due to the continuous feedback between these structures and the central

nervous system, all functions of the masticatory system act with maximum output and minimum power consumption and with no damage of orofacial tissues. Occasionally some local or systemic factors may interrupt the normal activity of the masticatory system components, where the disturbance of the activity of any of the component can lead to disorder of the whole system. In the literature this condition is commonly called temporomandibular disorder (TMD). Temporomandibular disorders represent a heterogeneous group of problems characterized by orofacial pain and/or masticatory dysfunction [1,2].

The prevalence of signs and symptoms associated with TMD can best be appreciated by reviewing epidemiologic studies [1,3-5]. These studies certainly suggest that signs and symptoms of TMDs are quite common in population. Important role in their creation have psychosocial factors (stress); trauma - that may be macrotrauma (any sudden force to the joint resulting in structural alteration), or microtrauma (functional overloading associated with muscular hyperactivity (bruxism) or occlusal instability); and occlusal conditions [1,6,7]. The relationship between occlusion and temporomandibular disorders is still a matter of controversy, and will probably remain if we just continue asking the question "Is there an indisputable connection?" without considering the complexity of the problem and the fact that in a biological system no single factor alone is capable of causing a disease or a functional disturbance of its own. Factors that cause a disease or a functional disturbance under certain circumstances may not cause it under others [8]. Occlusal factors may have different effects in different subjects, as suggested by the results of a randomized double-blind study of Le Bell [9]. Occlusion is certainly part of the puzzle, but definitely isn't a case of unconditional causal relationship.

DIAGNOSIS

The effectiveness and success of diagnosis and treatment of TMD lie in the ability of the clinician to establish the proper diagnosis [2,10]. This can be established only after a thorough examination of the patient for the signs and symptoms of functional disturbances. It is therefore very important that each sign and symptom be identified by means of a history and examination procedure. Clinical functional analysis must include a detailed and specific examination of each of component of the masticatory system in order to determine the relationship between the initial disturbance and the current problem. It usually begins with the detailed history of illness followed by clinical examination of masticatory muscles, examination of temporomandibular joints and assessment

of occlusal complex. Pain is certainly the most common complaint [11]. Sounds within the joint, although very common in the general population, have no clinical significance in the absence of pain [12]. The next important symptom is limited function of the lower jaw, which implies a limited range of movements in all directions [1]. As well as pain, limited function of the lower jaw causes significant problems in patients who encounter with difficulties in everyday activities such as eating, speech, etc.

A widely accepted muscle examination method is digital palpation. Three muscles basic to jaw movement but nearly impossible to palpate are inferior and superior lateral pterygoid muscles and medial pterygoid muscle. A method for evaluating symptoms in these muscles is called functional manipulation [13], and was developed on the principle that as a muscle becomes fatigue and symptomatic, further function elicits pain. Pain or tenderness in the temporomandibular joints (TMJ) is determined by the digital palpation of the joints when the mandible is both stationary and moving. Since TMD symptoms are often accentuated during function, it is common for patients to assume a restricted pattern of movement. Finally, in evaluating a patient for TMDs, the dental structures must be carefully examined. The most important is to evaluate the orthopedic stability between the intercuspal position and the TMJs. Furthermore, dental structures have to be examined for any breakdown that might suggest the presence of the functional disturbance.

TREATMENT

Procedures that are recommended for the treatment of temporomandibular disorders vary greatly and have a wide range of modalities. Moreover, accurately diagnosing and treating TMDs can be unpredictable task with limited outcomes. All methods of treatment used for temporomandibular disorders can be generally categorized into two groups: definitive treatment and supportive therapy [1]. While the definitive treatment refers to methods directed at controlling or eliminating the etiologic factors of the disorder, the supportive therapy refers to treatment methods directed toward alleviating the symptoms.

To confidently select an appropriate treatment, the clinician should demand adequate scientific evidence to support its use. Evidence –based practice supports the translation of scientific evidence into clinical practice. Randomized controlled trials are considered to be the most reliable way to estimate the effect of an intervention [14].

Treatment strategies for TMD are based on the goals of symptom reduction and improvement in function and quality of life, with an emphasis on therapies that are non-invasive and reversible. Irreversible therapies, including occlusal adjustments, orthodontics, prosthodontics rehabilitation and joint surgery may have value in some circumstances but the initial approach should be predicated on the principle of the simplest therapies first. The most common dental treatment is the use of stabilization occlusal splint. Several of the systematic reviews concluded that management of TMD with a stabilization splint is likely to lead to a short-term improvement when compared with placebo [15]. Stabilization splints were equally effective in reducing TMD pain compared to other treatment modalities such a physical medicine or acupuncture [16]. Documentation on the long term pain-relieving effect of occlusal appliances is limited.

Patient education includes the provision of information that ideally enables the patient to self-manage the condition [17]. Physical self-regulation (PSR) training is considered to be effective treatment strategy for the short- and long-term management of muscle pain in the facial region [18]. Although more clinical trials are needed to further evaluate the physical self-regulation approach, current data from clinical practice as well as from controlled scientific studies indicate that patients can receive some benefit from PRS training [19].

NEUROMUSCULAR DENTISTRY

In recent years much attention has been focused on neuromuscular dentistry – a new tool for diagnosing and treating TMD. Neuromuscular dentistry is the science of dentistry that embodies accepted scientific principles of patho-physiology, anatomy, form and function. It objectively evaluates the complex relationship between teeth, temporomandibular joints and the masticatory muscles in order to achieve an occlusion that is based on the optimal relationship between the mandible and the skull - a neuromuscular occlusion. The goal of the neuromuscular dentistry is to relax the muscles controlling jaw position to establish a true physiological rest position upon which treatment considerations are based. Neuromuscular dentistry uses computerized instrumentation to measure the patient's jaw movements via Computerized Mandibular Scanning (CMS) or Jaw Motion Analysis (JMA), muscle activity via electromyography (EMG) and temporomandibular joint sounds via Electro-Sonography (ESG) or Joint Vibration Analysis (JVA) to assist in identifying joint derangements (Table 1).

In order to prevent signal artefacts it is mandatory to adhere to certain strict rules of measurement. It has been demonstrated that relatively small variations

in electrode placement can significantly change EMG recordings (20). This means that recordings taken during multiple visits cannot be compared unless extreme care is taken to place electrode in the exact same location for each recording. Although it has been suggested that tracking devices can be used to diagnose and monitor treatment of TMDs, particular deviation of the mandible may not be specific for a particular disorder [21,22]. Therefore this information should only be used in conjunction with history and examination findings. Although sonography is the device that may accurately record joint sounds, the significance of these sounds has not been well established [23]. Furthermore, many healthy joints can produce sounds during certain movements. If sonography is to have meaning, it must be able to separate sounds that have significance from those that do not.

EMG recordings have been proven to provide excellent information on muscle function under research conditions [24,25]. They are also useful with various biofeedback techniques by enabling the patient to monitor muscle contraction during relaxation training [26,27].

Since the etiology of TMD is not well understood, the standard of care for TMD emphasizes conservative and reversible treatments such as patient education, intraoral splints, and behavioural interventions. Among the latter, electromyographic (EMG) biofeedback, relaxation training and stress management counselling, either alone or in combination, have been used to treat TMD for more than three decades. A 1987 review [28] of the sparse literature then available on the effectiveness of treatments that incorporated EMG biofeedback concluded that biofeedback approaches were „clearly promising“ but lacked definitive experimental support because of the absence of appropriately designed studies. A 1999 meta-analysis [29] of the EMG biofeedback treatment of TMD showed that although limited in extent, the available data support the efficacy of EMG biofeedback treatments for TMD. In the study of Crider et al [30] biofeedback training was reported to be an efficacious treatment of TMD. Furthermore, both biofeedback training and the sole intervention and the biofeedback-assisted relaxation training were effective.

Almost all systematic reviews on the effect of behavioural therapy on TMD concluded that this type of treatment was effective in treating TMD pain. Although a limitation of most of these reviews was that studies had small number of participants or there were variations in methodology, current data from clinical practice as well as from controlled scientific studies indicate that patients can receive some benefit from behavioural therapy.

Table 1. Neuromuscular diagnostics and treatment

COMPUTERIZED MANDIBULAR SCANNING (CMS)	ELECTROMYOGRAPHY (EMG)	ELECTROSONOGRAPHY (ESG)
analyzes, in three dimensions, the delicate functioning movements of the jaw with accuracy in tenths of a millimeter	measures and analyzes the electrical activity in the muscles	recordings of sounds produced within the jaw joint
opening, closing, swallowing and chewing movements	at rest and during function	opening and closing of the mouth
recordings of the movement of a small magnet temporarily attached to the gum below the lower front teeth	surface electrodes attached on the face, forehead, side of the head and beneath the chin	placement of a headpiece similar to that of a head set with vibration sensors (transducers) over the two temporomandibular joints
to evaluate the accuracy of jaw position at the treatment occlusion	EMG activity before and after <i>TENS (electrical stimulation therapy)</i> to relax muscles) as well as the functioning (clench) EMG activity	the frequency and amplitude of the noise, as well as the position in the opening/closing at which sound is produced

CONCLUSION

In order to safely choose the appropriate diagnostic or treatment method, the clinician should analyze and assimilate all of the information obtained from the patient's history, clinical examination and various diagnostic tests described above. The computerized testing, which provides valuable information, does not make a diagnosis by itself. It is the trained doctor, assessing all the outcomes, who makes the diagnosis and determines the appropriate treatment plan. This task can be facilitated by neuromuscular dentistry that treats temporomandibular disorders by creating a balance between the joints, the bite and the muscles. However, we still need further research that would lead towards evidences necessary to choosing appropriate treatment methods.

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Sažetak

Temporomandibularni poremećaji – uloga neuromuskularne stomatologije

Poremećaji funkcije žvačnog sustava (tzv. temporomandibularni poremećaji) problem su s kojim se sve češće susrećemo u svakodnevnoj praksi. Kliničari se uglavnom slažu u tome da najvažniju ulogu u njihovu nastanku imaju psihosocijalni čimbenici (stres), trauma – koja može biti makrotrauma, kao što je npr. udarac u čeljust, ili mikrotrauma, ona povezana s kroničnom mišićnom hiperaktivnošću (bruksizmom) ili okluzijskom nestabilnošću – te okluzijski uvjeti.

Neuromuskularna stomatologija moderan je oblik dijagnostike i liječenja tih poremećaja. Ona objektivno procjenjuje kompleksan odnos između zubi, žvačnih mišića, temporomandibularnih zglobova i kranijalnih živaca kako bi među njima postigla sklad. Za razliku od standardnih dijagnostičkih metoda kliničke funkcijske analize kojima se koristi tradicionalna stomatologija, neuromuskularna stomatologija u tu se svrhu koristi različitim kompjutoriziranim suvremenim tehnikama kojima se bilježi pomicanje donje čeljusti (analiza kretnji donje čeljusti), registriraju mišićnu aktivnost (elektromiografija) i identificiraju zvukove zgloba (elektrosonografija i analiza zglobnih vibracija).

Činjenica je ipak da do danas još uvijek ne postoji dovoljan broj randomiziranih dvostruko slijepih kliničkih studija koje bi nam mogle objektivno pomoći u odabiranju odgovarajućeg načina dijagnostike i liječenja, a koje će u budućnosti zasigurno doprinijeti rješavanju enigmi temporomandibularnih poremećaja.

Ključne riječi: temporomandibularni poremećaji; neuromuskularna stomatologija; žvačni mišići.

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