

# KINESIOLOGICAL ANALYSIS OF THE FUNCTIONAL RELATIONSHIP OF TEMPOROMANDIBULAR JOINT AND ATLANTO-OCCIPITAL JOINT – DIAGNOSIS AND POSSIBLE THERAPY

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Various pathological processes in the orofacial area are involved in the genesis of dysfunctions of the temporomandibular joint, such as inflammation, multiple mechanical disorders, rheumatic diseases, stress, as well as mental disorders. The aim of this review is to draw attention to functional linkage of this joint with the atlanto-occipital joint via suprahyoid muscles. They have origin in the skull base, hyoid and jawbone, so these two segments interact with each other. Disorder of the temporomandibular joint is primarily in the domain of dentistry and jaw surgery. Of many possible causes, it is clear that it is a cross-sectoral problem. The functional nature and connection with the surrounding movement elements integrates them into the sphere of physiotherapy interest. The knowledge of these functions and their coordinations is essential for physiotherapeutic practice in this sector.

**Key words:** atlanto-occipital joint, functional disorders, rehabilitation, temporomandibular joint

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## INTRODUCTION

According to many authors, 80%-90% of the population suffer from myoskeletal system disease (1). Functional disorders of the musculoskeletal system include disorders of joints, muscles, nerves and other soft tissues, organs, organ systems and the whole body, when their formation is not conditioned by an organic, structural cause. Functional failure is then a malfunction of the control function. The most significant manifestations are muscular imbalance, changes in the extent of articular mobility and wrong movement stereotypes (2). Hypokinesia, a change of lifestyle and poor muscle status are considered as the main causes of musculoskeletal system disorders (3). Wrong body posture, muscle imbalance and disorder of muscle chains (postural changes) lead to the occurrence of recurrent functional disorder (4). Insufficient

or inappropriate care of the locomotor system is often caused by the population's poor awareness of locomotor lifestyle. This results in maintaining unfavorable condition, which then leads to chronic problems or development of structural disorders.

The functional consequences of inappropriate movement regime and comfortable lifestyle can also involve cervical spine, i.e. the atlanto-occipital (AO) segment. Suprahyoid muscles (*musculi suprahyoidei*) are also significant as they originate in the AO area. If they are hypertonic, they can cause the skull base to move forward towards C1 (atlas). The insertion of suprahyoid muscles is located in the lower jaw area, therefore these two segments are functionally interconnected, and that is why they interact. This explains the functional relationship between temporomandibular disorders (TMD) and postural changes (5).

## THE MECHANISM OF TEMPOROMANDIBULAR JOINT DYSFUNCTION

Temporomandibular disorders have a multifactorial pathogenic background and a very varied clinical picture (6). According to the previously accepted psychophysiological concepts, occlusive problems and emotional stress were considered as the important etiologic factors (7). The causes of temporomandibular dysfunction development are much more complex (8). Different pathological processes are involved in the genesis of temporomandibular joint (TMJ) dysfunction. In the orofacial area, inflammation of the nasal cavity and sinuses, gingivitis, laryngitis, otitis, trigeminal nerve inflammation, tooth pain, etc. are quite frequent. Once the inflammation has cleared, the post-inflammatory changes such as stiffness or retention may occur in the surrounding soft tissues, thus modifying their consistency, which in turn adversely affects their function. The onset of difficulty can lead to poor dental condition, chromium, tooth and gum disease, bruxism and bruxomania, and incorrect articulation. Of the otorhinolaryngological (ear-nose-throat, ENT) causes, mention should be made of ear and ear canal disease, scars left after ENT surgery, and tumors of the oral cavity and ENT area (9). Other causes include rheumatic diseases (TMJ involvement has been described in a number of rheumatic diseases) (10), stress and psychological disorders that are responsible for spasm of the chewing muscles. It is assumed that cervical postural deviations are correlated with TMD through the muscles of the stomatognathic system (11). Specifically, both forward head posture and cervical spine alignment are found to be implicated in TMD (12, 13). The cooling effect of TMJ does not arise, but it may aggravate symptoms and trigger its manifestation.

These heterogeneous disorders and diseases can cause increased muscle tone and stiffness of the surrounding binding agent functionally associated with TMJ. As a result, there is an uneven distribution of forces acting on the joint, thus causing changes in the extent of the movement of a jaw, its asymmetric motion range, changes in the mandible resting position and disease of locomotor stereotype.

The same pathophysiological mechanism of TMJ-induced defects can be applied to the articular functional block of the AO joint. In this case, there is a functional relationship between these two structures through the over-the-muscles that interact with each other.

These functional changes of multifactorial origin often do not disappear with recognition of the primary illness subsiding. Functional disorders are often preceded by structural disorders (14).

## EXAMINATION OF TEMPOROMANDIBULAR JOINT FUNCTION

Temporomandibular joint is a complex anatomic, kinesiological and functional unit that is responsible for chewing, talking and swallowing. Functionally, it includes jaw joints, chewing muscles, neck and neck muscles and adjacent nervous system with highly sensitive receptors. It further includes teeth and adjacent bones, including upper and lower jaws, and temporal bone (15). It is a pair of joints, so when moving it always moves the right and left joints together. It is characterized by the fact that the pathological process is generally asymmetric. This means that a functional disorder on one side may become painful on the other side, which should be considered when making the diagnosis. We always examine both sides. We observe symmetry of the face and jaw position (chin position to the middle line). By palpation we detect the tone of chewing, suprahyoid muscles and their pain. We also focus on evaluation of the dynamics, range of symmetry of TMJ movement. We investigate elevation and depression, late-pulsing, prolapse and retraction of the mandible (16). The extent of jaw depression is established by distance of the upper and lower canines (minimum opening for two fingers). In the initial phase of jaw depression, we focus on the presence of excessive translational and rotational movements, which indicates instability. If translational movement to one side is limited, it indicates a contralateral joint disorder (17). The suprahyoid muscles play a significant role in relation to functional disorders in the AO junction.

### SUPRAHYOID MUSCLES

Suprahyoid muscles (*m. digastricus*, *m. stylohyoideus*, *m. mylohyoideus*) form the oral cavity, fix the larynx, and their effect is manifested in movement of the hyoid bone (18). They are directly related to development of functional disorders in the AO area. Because they have insertion on skull base, their increased pull directly causes functional blockage in the area of head joints. The blockage acts as a source of nociceptive signaling, which causes increased tension in the muscles of cervical spine.

Suprahyoid muscles are examined by touch. We palpate front of the neck, literally from hyoid bone (16). With gentle pressure by the second and third fingers, we work through to dorsal media and caudal direction. We establish increased muscle tension that is symmetric or maybe asymmetric, which indicates limited hyoid bone movement towards media. Functional disorders often arise as a result of this asymmetric action on TMJ.

## ALTANTO-OCCIPITAL JOINT

Atlanto-occipital joint belongs not only to cervico-thoracic but also to thoraco-lumbar transition, into the so-called key area of the spine (16). The articular functional block in AO joints causes change in the position of head center and consequently of the entire body. This results in change in the muscle tone of adjacent muscles, which also affects the dynamics of cervical spine and thus all functions of the spine, including sacrum bone and pelvis. As a result of these links, there is incorrect loading and overloading upon various spinal segments and development of functional disorders even in distant segments.

### CLINICAL VIEW OF ATLANTO-OCCIPITAL BLOCKAGE

Joint function blockage in the AO joint area has various manifestations, e.g., pain, tinnitus, dizziness, nausea, tingling of the face and tongue. The pain is primarily located in the back of head, where it can radiate in proximal direction, into one-half of the head, face, ear, eye and forehead. Distant direction can radiate to the entire cervical spine up to the blade.

### CAUSES OF FUNCTIONAL BLOCKAGE OF THE ATLANTO-OCCIPITAL JOINT

The cause of functional blockage of the AO joint is uneven distribution of force onto the joint and overloading (16). In our opinion, it is often caused by thrust of hypertonic and shortened suprahyoid muscles. Through functional enchainment, the blockage can be caused by dysfunction of other segments such as sacroiliac joints, vertebrae joints, shoulder joints and, the last but not the least, TMJ.

### METHODS OF THERAPY

Currently, there are a number of therapeutic techniques and procedures available to influence functional disorder in TMJ and AO joint area. Machoň *et al.* describe causative treatment of TMJ, whose role is to eliminate or reduce the effect of predisposing factors, and symptomatic, which focuses on pathological condition of the joint, to reduce pain, increase opening, remove sound phenomena, etc. (15).

Physical therapy, particularly exercise and mobilization of TMJ with masticatory muscles, have a very important role in the treatment (19). Generally, the integrated method of performing kinesitherapy of the

masticatory system by Schulte has been accepted (20). This method is based on self massage and exercises (kinesitherapy).

Rashid *et al.* consider jaw exercises, ultrasound, manual therapy, acupuncture and laser therapy affective when treating TMJ disorders (21).

Due to functional connection of TMJ and AO joints, it is necessary to deal with TMJ dysfunctions, as well as with AO joint disorders. At the end, we search for disorders in other segments. By use of soft techniques, we influence the tone and consistency of tissues that adjust to joint, and through post-isometric relaxation (PIR) we correct the length of muscles. The more so, Oliveira-Campelo *et al.* report that the application of an atlanto-occipital thrust manipulation or soft tissue technique targeted to the suboccipital muscles leads to an immediate increase in pressure pain thresholds over latent trigger points in the masseter and temporal muscles, as well as in maximum active mouth opening (22).

Furthermore, joint mobilization is also used in physiotherapy that reduces pain and improves maximum mouth opening pressure pain threshold in subjects with TMD (23). It mobilizes within restricted directions. Active mandible exercises can be performed by the patient after removing TMJ asymmetry.

As additional treatment, physical therapy is applied to the TMJ area. If there is no metallic material or amalgam seal present in the area, we then apply transcutaneous electro-neurostimulation (TENS) for analgesia, or lower the dose of ultrasonic therapy (0.1-0.3 W/cm<sup>2</sup> a cca 3 MHz), which has a secondary analgesic effect. By massaging chewing muscles through the mouth (*m. masseter*, *m. pterygoideus medialis*) we achieve their relaxation. Phototherapy (polarized light – laser or biolamp) is mainly used for healing soft tissue. Similarly, laser therapy is also a valuable tool that can significantly decrease the perception of pain in TMJ dysfunction in acute and chronic stage of the disease (24).

When treating AO blockage, it is important to focus on the cervical spine muscles, whose spasm can be both primary and secondary. For this reason, we apply PIR, soft techniques, classic or reflex massage, ultrasonic therapy or positive thermotherapy.

Essential are aimed physiotherapy exercises focusing on stretching shortened neck and neck muscles, alleviating their increased tension and correcting incorrect movement stereotypes. If muscle spasms and contractions are removed, mobilization or spinal thrust manipulation directed to the upper cervical segments (AO joint) (25) may be performed as necessary. De-

compression traction also has a beneficial effect on TMD, in therapeutic treatment of cervical spine. It is also important to instruct the patient about self-management of the relevant segment. We will teach the patient how to perform PIR on chewing muscles, short and long neck extensions, and how to correct incorrect body posture.

## LOCOMOTOR LIFESTYLE

Because health cannot be taken for granted, we must invest into it our own physical effort, discipline, influence our behavior and achieve self-control, which is also associated with motivation for regular exercise (26). This especially applies to diseases of the musculoskeletal system because muscles are subject to our will. Proper mobility is not only an important key to prevention, but also to treatment of many diseases. It is part of healthy lifestyle that is the expression of human individuality, it is a specific type of behavior of an individual or social group (27).

General principles of the locomotor lifestyle include harmony between activity and rest. Insufficient physical activity leads to weakening of skeletal muscles and reduction of some muscular groups, thus disrupting movement stereotypes. When performing incorrect movements, the structure and tissue of the locomotor system can be overloaded and damaged, and consequently degenerative changes may occur. Excessive physical strain can lead to connective tissue microtraumas, increased fatigue, pain and formation of incorrect motion stereotypes. Mental state is also important when treating musculoskeletal disorders (28).

In order to reduce the symptoms of TMJ diseases, it is necessary to follow specific principles:

- avoid chewing hard foods,
- eliminate excess depression of jaw bone, e.g., when yawning,
- avoid bruxomania,
- when sitting at a table, not to lean on the table with elbows and support chin,
- sleeping on stomach with head rotated to one side,
- not to hold the phone between shoulder and jaw,
- stay warm, and
- eliminate stress.

## CONCLUSION

Temporomandibular joint disorders were primarily the domain of dentistry and jaw surgery. Of the many possible causes, it is clear that this is a cross-sectoral problem. Besides the functional nature and connec-

tion with surrounding movement elements, it also integrates them into the sphere of physiotherapy interests. Due knowledge of these functional relationships and their correlation is essential for physiotherapeutic practice in this field. In this article, the authors describe functional correlation of the temporomandibular joint and atlanto-occipital joint *via* suprahyoid muscles.

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## SAŽETAK

### KINEZIOLOŠKA ANALIZA FUNKCIONALNE POVEZANOSTI TEMPOROMANDIBULARNOG ZGLOBA I ATLANTO-OKCIPITALNOG SPOJA – DIJAGNOSTIKA I MOGUĆNOSTI LIJEČENJA

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Različiti patološki procesi u orofacijalnom području, kao što su upale, različite mehaničke pogreške, ali i reumatske bolesti, stres i psihički poremećaji doprinose nastanku disfunkcija temporomandibularnog zgloba. Cilj ovoga pregleda je skrenuti pozornost na funkcionalnu povezanost ovoga zgloba s atlanto-okcipitalnim spojem i to putem nadjezičnih mišića. Imaju zajedničke polazne točke u bazi lubanje, podjezičnoj kosti i donjoj čeljusti te se zbog toga ova dva segmenta međusobno uvjetuju. Poremećaji temporomandibularnog zgloba bili su ponajprije domena stomatologije i oralne kirurgije. Međutim, iz niza mogućih uzroka je jasno da se radi o interdisciplinarnom problemu. Funkcionalna priroda i povezanost s okolnim elementima kretanja svrstava ih i u područje interesa fizioterapije. Poznavanje ove funkcionalne povezanosti i spajanja je neophodno za fizioterapijsku praksu u ovom području.

**Ključne riječi:** atlanto-okcipitalni spoj, fizioterapija, funkcionalni poremećaji, temporomandibularni zglob