Emotional Stress
and
TMJ

Matvey Kipershtein B.A., R.M.T.

1. Introduction

This article will explore the connection between emotional stress and various manifestations of temporomandibular joint (TMJ) dysfunction (TMD).

Due to disparate descriptions of emotional stress in literature, it is necessary to provide a baseline definition of emotional stress for the use in this paper.

While some authors define emotions in terms of their biochemical composition (Pert, 1997), others describe emotions and emotional stress as a personal, subjective experience that is elicited by a stressor specific for the individual and that can be objectively measured as a physiological response (Ohrbach, Blascovich, Gale, McCall, & Dworkin, 1998). Another approach is of eastern origin, where the emotions are viewed as a reflection of current body sensations based on previous experiences (Sogyal, 2002). The article "The Experience of Emotion" provides a good overview of the current outlook on emotions (Barrett, Mesquita, Ochsner, & Gross, 2007).

For the purpose of this work we have adapted the approach suggested by Ohrbach et al. that measures emotional stress in terms of biological changes which can be objectively determined by an independent observer through various technological means (Ohrbach et al., 1998).

Based on the above definition of emotional stress, this article will explain why many clinicians including dentists, physiotherapists, Osteopaths, and massage therapists notice that TMD can often be observed in patients with high levels of emotional stress.

When questioned, such patients report active emotional issues caused by life events such as separation, abuse of all natures, study or work overload.

Emotional stress plays an integral role in the development of TMD. Stress exacerbates both the severity and duration of bruxism (grinding of the teeth) during sleep. In addition, many people unconsciously clench or grind their teeth while they are awake. Stress also contributes to TMD because a person's pain sensitivity and susceptibility to inflammation increase.

A number of studies prove that emotional states can be good predictors of jaw pain levels (Glaros, Williams, & Lausten, 2005). Anxiety, depression, and stressful life events are highly correlated to TMD. While it is recognised that emotional stress may be an etiological factor in TMD, it is equally important to note that anxiety or depression may also result from TMD (Rugh, Woods, & Dahlstrom, 1993).

This paper will review the interconnection between emotional stress and TMD via various systems of the body and give a short comparison of dental and osteopathic approaches to the treatment of TMD.

2. Effects of emotional stress on body and TMJ

The temporomandibular joint (TMJ) is composed of several overlapping types of tissues and body systems. They include nervous, musculoskeletal, vascular and visceral system.

The influence of emotional stress on each of these systems and their interrelationships pertaining to TMJ will be reviewed in the following chapters.

2.1. Effects of emotional stress on nervous system

This section will describe brain centres involved in emotional responses and their interconnection with neuronal network responsible for the control of mastication. It will also explain how stress affects neurotransmitters and influences pain perception in the case of TMD.

In the review article on the subject of cortical control of mastication the authors describe the following neuronal network. Cerebral cortex provides input to contralateral brainstem structures via cortico-bulbar tract. Brainstem then activates a relay in the medial pontomedullary reticular formation that eventually triggers the trigeminal motor nuclei and activates jaw opening and closing muscles (Lavigne, Kato, Kolta, & Sessle, 2003).

Using MRI and PET scans, the following areas have been shown to be active during mastication: cortical primary somatosensory area, supplementary motor area, insula, cerebellum, and striatum of basal ganglia (Momose et al., 1997).

In addition to the above structures, other cerebral structures associated with the generation of jaw movement include lateral hypothalamus, anterior-lateral or central nuclei area of amygdala, thalamic reticular nuclei, mesencephalic reticular

formation, pontine pyramidal tract, and red nuclei. Since the involvement of these structures in emotional responses has also been demonstrated in various brain mapping studies (Barrett et al., 2007) (Onozuka et al., 2002), it can be hypothesised that activation of these centres during a strong emotional experience can trigger jaw movements as well.

In the article describing the neurological mechanisms involved in sleep bruxism the authors cited an animal study that demonstrated that the stimulation of hypothalamic 'defence attack area' facilitates a jaw-closing muscle reflex, which indicates that the trigeminal system is activated in aggressive behaviour. In the same review it has also been shown that central amygdaloid nuclei project to the contralateral trigeminal motor nuclei, supratrigeminal area, and pontine reticular formation. Both these findings support a connection between emotional brain activity and trigeminal sensorimotor functions (Lavigne et al., 2003).

Another study shown that chronic stress causes greater subjective distress in acutely stressful situations. This study also found increased levels of epinephrine and lower peak levels of β-endorphin during stressful events (Pike et al., 1997). These facts indicate that the increased sympathetic tone in stressful situation can further exacerbate the symptoms of TMD, while the decrease of β-endorphin levels can increase perceived pain.

The above findings show how emotional stress can activate brain centres responsible for mastication and increase pain perception by changing the amount of pain modulating chemicals.

2.2. Effects on musculoskeletal system

Musculoskeletal system pertaining to TMJ consists of the osseous and cartilaginous framework, attached musculature and supporting fasciae. Emotional stress influences this system through change in mechanical forces and hormonal levels. The mechanism of these influences as well as interrelationship between various components of musculoskeletal system will be explained in the following chapters.

2.2.1. Effects on muscles

At least twenty five muscles are associated with the structures forming TMJ. Several studies including that by Ohrbach et al. demonstrate that during times of emotional stress TMJ muscles show signs of increased tonicity (Ohrbach et al., 1998).

Application of emotional stress in the above study was achieved through the use of an imaginary script based on an event in the subject's life. A great degree of emotional involvement in this research suggests a connection between objectively measured emotional stress and increased masticatory muscle activation. Aforementioned increase in the muscle tone is implicated in the effects of emotional stress on bones, fascias, vascular and visceral systems. This influence will be further expounded in the following chapters.

2.2.2. Effects on bones and cartilage.

In addition to cortical and trabecular bone, TMJ is composed of hyaline cartilage and dense fibrous tissue. The hypothesis of this chapter is that bruxism and increased muscle tone during emotional stress (Glaros et al., 2005) will affect the aforementioned articular structures.

Previous chapter has shown that emotional stress can increase masticatory muscle tone and thus can also create additional load on articular structures.

A number of animal studies demonstrate plastic changes in cranial skeleton as a result of an increased load on TMJ (Ravosa, Kunwar, Stock, & Stack, 2007) (Bouvier & Hylander, 1981). Similar human experiments have not been conducted for ethical reasons.

Rabbits placed on an exclusive diet of hard to chew food showed changes in TMJ similar to age-related onset of cartilage degradation that is linked to decrease in proteoglycan content (Ravosa et al., 2007). In the same study, TMJs of rabbits that ate normal food were able to resist compressive stresses better than TMJs of rabbits with repetitively overloaded cranial joints. The researchers also concluded that routine overloading of TMJ induces accelerated chondrocyte death and articular cartilage degradation. The authors postulated that the adaptive increases in TMJ proportions and biomineralization represent a compensatory mechanism to cartilage degradation due to a long term joint overloading (Ravosa et al., 2007).

The effects of bruxism and increased muscle tone following emotional stress can be compared to the effect of hard diet used in the above study. This increase in masticatory load modifies TMJ biomechanics, and can cause degenerative

changes in the cartilage together with altered mineralization of the cranial bones. It is also interesting to note that biomineralization changes in the bones described in the animal experiment (Ravosa et al., 2007) correlate with osteopathic findings, such as compaction of the joint or intraosseous lesions (Zverev & Remizov, 2007).

2.2.3. Effects on fascias

Although fascia is continuous everywhere, at least thirteen fasciae with distinct names have been linked to TMJ.

In times of emotional stress, fascia will be influenced by the change of muscle tone and consequently will create tension on the neuromuscular structures located within its layers. Furthermore, alteration in hormonal levels during emotional stress will also affect fascia.

We have established in a previous chapter that emotional stress causes increase in muscle tone. Cathie explains how this abnormal muscular tension can be transmitted through the fascia via several mechanisms (Cathie, 1952). Fascial tension will in turn affect local nerves that are embedded within the layers of connective tissue. For example, there are important connections between neuromascular and fascial structures that are commonly involved in TMD: stylomastoid foramen for the exit of facial nerve, and mandibular nerve within the fascia of the pterygoid muscles and their attachment to the skull base (Cathie, 1952). Hence, a variety of TMD symptoms from emotional stress can be caused by disturbances to the above structures. Some of these symptoms include facial

muscle spasms and pain from facial nerve irritation, and compression of the trigeminal nerve causing abnormal masticatory muscle tone and facial pain. These sensations of pain can cause further emotional disturbance, facilitating the vicious cycle of TMD and emotional stress.

Fascia is also highly influenced by various hormones. For example, somatotrophic hormones have a direct effect upon connective tissue cells. Selye has demonstrated that during emotional stress somatotrophic hormones help mineralocorticoid hormones stimulate inflammation in connective tissues (Selye, 1978).

Furthermore, natural killer cell activity decreases in the peripheral structures during stress (Pike et al., 1997). This explains the change in the immune response and can point to altered states of inflammation in peripheral structures pertaining to TMJ.

Thus, we have demonstrated how during emotional stress the muscular tension will be transmitted through the fasciae and influence the neuromuscular structures causing pain while further facilitating muscle spasm. Additionally, the pain levels in TMD can significantly increase as a result of an inflammation in the fascia.

2.3. Effects on vascular system

Vascular system is affected by emotional stress via its influence on sympathetic nervous system. Moreover, emotional states have also been experimentally linked to changes in the vascular tone.

There is a connection between the carotid sheath of the upper part of the sympathetic chain and the loose areolar tissue supporting neurovascular structures (Cathie, 1952). Having established the interrelationship between emotional stress and fascial tension in the previous chapter, it is conceivable to see how tension on these fascial structures can create cervical sympathetic ganglia disturbances resulting in abnormal vascular tone in the head.

Furthermore, emotional stress expressed as anger has been scientifically linked to vasoconstriction (Rabineau, Treiber, Poole, & Ludwig, 2005).

So in addition to autonomic nervous system disturbance to the blood vessels pertaining to TMJ, there is also a vasoconstriction which will further restrict the blood supply to TMJ.

2.4. Effects on visceral system

The TMJ is intimately related to several visceral systems such as hearing, balance, and digestion.

Reflex muscular contraction is present in tensor tympani and tensor veli palatini muscles in rhythmic opening and closing of the Eustachian tube. In TMD, these muscles can exhibit tonic spasm due to the irritation of cranial nerves V and VII. Such muscular behaviour may correspond to a reflex pattern due to a constant fatigue of these muscles during emotional tension and stress (Klockhoff, Lindholm, & Westerberg, 1971). Sustained contraction of these muscles in TMD may alter inner ear perilymphatic and endolymphatic pressure through changes transmitted from the oval window toward the walls of the labyrinth and

semicircular canals. This may lead to vestibular and cochlear impulse imbalance and symptoms such as vertigo, hearing loss, tinnitus, and ear ache (Ramirez, Ballesteros, & Sandoval, 2007). So the above symptoms can further exacerbate the emotional stress of the patient.

Rhythmic jaw movements during sleep can contribute to the release of saliva to protect, through a lubricating action, the integrity of oro-esophageal structures. (Lavigne et al., 2003). Lack of salivation (dry mouth) is a well known effect of emotional stress. This example clearly demonstrates how sleep bruxism, which involves rhythmic jaw movements, can be an essential adaptation to the lack of salivation caused by stress. Moreover, bruxism is viewed by some authors as subconscious effort of the patient to relieve cranial lesions.(Magoun Harold I. & Sutherland Cranial Teaching Foundation., 1976, p. 235)

Information provided above gives an explanation how the sense of balance and hearing are disturbed in the case of TMD and thus cause more emotional stress. Additionally, bruxism can be used by the body as a means to protect the digestive tract during emotional stress. So, emotional stress can also be understood as an eatiologic factor in TMD.

The data presented in the above chapters shows multitude of interrelationships between various systems of the body in their responses to emotional stress. Furthermore, within the complex picture of the TMD, the emotional stress can be viewed either as a cause or as a symptom of the dysfunction.

3. Osteopathic and traditional dental approaches to TMD

This chapter provides a short overview and comparison of the dental and osteopathic approaches to the treatment of TMD.

Traditional dental approach to TMD does not usually take into consideration the possibility of inherent sutural mobility of the cranial bones, yet it recognizes that the skull is not a fused unit, and the bones can separate. Dentistry offers TMJ treatments that emphasize bone remodelling resulting from the application of strong compressive and destructive forces by means of tooth removal and splint application.

The most dramatic example of sutural remodelling is the result of rapid maxillary expansion, when a diastema is opened between the central incisor teeth. This technique uses a screw mechanism apparatus that produces a separation of the two halves of the maxilla. To be effective, the magnitude of the applied force must be strong enough to be transmitted beyond the periodontal joints; otherwise, the stresses will be absorbed within the alveolar bone, resulting in tooth movement alone (Meikle, 2007).

The dental profession has provided convincing histological evidence that the influence of orthodontic treatments is not limited to the teeth, but extends to other parts of the mandible, causing remodelling of the glenoid fossa and the condyle. This approach currently offers functional appliances that influence chondrogenesis and bone formation to correct malocclusions and thus eliminate the symptoms of TMD (Meikle, 2007). However, a study that compared various splint therapies with a conservative physiotherapy approach concluded that

patients of all groups improved equally over time, while traditional splint therapy offered no benefit over the athletic mouth guard splint therapy. Furthermore, splint therapy did not provide a greater benefit than did self-care treatments without splint therapy (Truelove, Huggins, Mancl, & Dworkin, 2006).

These conflicting results might stem from a disregard for the multitude of interconnections among cranial, facial and other structures while the study has solely focused on the mechanical and biological stresses of the masticatory apparatus.

On the other hand, Osteopathy provides a very distinct approach to TMJ treatment. Harold I. Magoun Sr. places the greatest significance on external and internal rotation lesions of the temporal bones that change the position of the temporal fossae to respectively posteromedial and anterolateral. He also notes that bruxism is merely an effort on the part of the patient to correct the bony misalignments. He further expands the relationship of the whole body structural imbalances to TMD, such as the connection between short leg and proper dental occlusion as well as the autonomic nervous system function in connection with cervical spine lesions and their effect on TMD symptoms. There is an interesting case of a woman coming to a hospital with a heart problem and severe headaches after dental correction of her bite. Her “heart spell” was relieved after an osteopathic treatment of her cranial and cervical lesions. At the same time her headaches have persisted as a result of the changed bite (Magoun, 1975).

Despite the outlined differences in dental and osteopathic approaches, there is a growing number of orthodontists that have come to appreciate the mobility of the

cranial bones and the multitude of interconnections between the TMJ and the rest of the body. These practitioners use Advanced Lightwire Functional (ALF) appliances to adjust the positioning of teeth, restore the proper movement of cranial and facial bones, and thus alleviate the symptoms of TMD. ALFs are designed mainly to assist in the correction of cranial lesions and only secondarily to move teeth. Hence, the force is slight enough to be absorbed by the patient's primary respiratory mechanism (James. & Strokon). The prescription of ALFs requires a proper diagnosis of the cranial lesion patterns. In addition, some dentists have started to use such modalities as cranio-sacral therapy to complement their dental care (Fortinsky, 2007).

This overview demonstrates the differences and similarities in dental and osteopathic approaches to the treatment of TMJ. The information provided in this chapter shows the importance of communication between osteopathic and dental practitioners, and the need to apply dental equilibration with respect to the cranial physiology as it is viewed by the osteopathic profession.

4. Conclusion

This paper has shown how the emotional stress, when defined as an influence causing biological changes which can objectively be determined by an independent observer, affects TMJ. This influence acts upon the body through musculoskeletal, nervous, visceral and circulatory systems and causes a variety of TMD symptoms.

While the emotional stress may be a cause of TMD, it is also important to note that emotional disturbances may also result from the somatic dysfunction.

Various sources cited in the paper show a number of connections between emotional stress and physiological processes in the body.

The evidence of increased muscle tone during emotional stress as well as facilitation of nervous control centres explained in the previous chapters can play a leading role in establishing further effect on the entire body. Fasciae transmit abnormal muscular tensions while osseous and cartilaginous framework adapts to the increased load. Blood supply is altered as a result of emotional stress, and visceral system reacts by producing disturbances in hearing, balance and digestion. It is clear how the interaction of various structures and systems of the body provides functional response to emotional stress in TMJ.

Body works as a unit, so the emotional stress reported by the patients is just a part of the clinical picture. It can be suggested that the most efficient way to treat TMJ should therefore encompass multidisciplinary approach. Body has a great self healing ability, and in order to successfully treat the patient, practitioners need but remove the obstacles to health. So emotional stress can be described as an

etiological factor and treated as such by a qualified practitioner. On the other hand, if emotional issues arise or are exacerbated as a result of somatic TMD symptoms, osteopathic approach in conjunction with appropriate dental protocols can provide the right course of action.

5. Bibliography

Barrett, L. F., Mesquita, B., Ochsner, K. N., & Gross, J. J. (2007). The experience of emotion. *Annu Rev Psychol, 58*, 373-403.

Bouvier, M., & Hylander, W. L. (1981). Effect of bone strain on cortical bone structure in macaques (Macaca mulatta). *J Morphol, 167*(1), 1-12.

Cathie, A. G. (1952). Fascia of the head and neck as it applies to dental lesions; a preliminary consideration. *J Am Osteopath Assoc, 51*(5), 260-261.

Fortinsky, G. (2007). Complementary Dental Therapies and Their Education. *Oral Health Journal*.

Glaros, A. G., Williams, K., & Lausten, L. (2005). The role of parafunctions, emotions and stress in predicting facial pain. *J Am Dent Assoc, 136*(4), 451-458.

James., G. A., & Strokon, D. P. The advanced Lightwire Functional (ALF) Appliance and Cranial Bio-Mechanics Seminars.

Klockhoff, I., Lindholm, L., & Westerberg, C. E. (1971). [Spontaneous impedance fluctuation--a "tensor tympani syndrome" with special reference to tension headache]. *Nord Med, 85*(18), 577.

Lavigne, G. J., Kato, T., Kolta, A., & Sessle, B. J. (2003). Neurobiological mechanisms involved in sleep bruxism. *Crit Rev Oral Biol Med, 14*(1), 30-46.

Magoun Harold I., & Sutherland Cranial Teaching Foundation. (1976). *Osteopathy in the cranial field* (3d ed.). [s.l.: s.n.].

Magoun, H. I., Sr. (1975). Dental equilibration and osteopathy. *J Am Osteopath Assoc, 74*(10), 981-991.

Meikle, M. C. (2007). Remodeling the dentofacial skeleton: the biological basis of orthodontics and dentofacial orthopedics. *J Dent Res, 86*(1), 12-24.

Ohrbach, R., Blascovich, J., Gale, E. N., McCall, W. D., Jr., & Dworkin, S. F. (1998). Psychophysiological assessment of stress in chronic pain: comparisons of stressful stimuli and of response systems. *J Dent Res, 77*(10), 1840-1850.

Onozuka, M., Fujita, M., Watanabe, K., Hirano, Y., Niwa, M., Nishiyama, K., et al. (2002). Mapping brain region activity during chewing: a functional magnetic resonance imaging study. *J Dent Res, 81*(11), 743-746.

Pert, C. B. (1997). *Molecules of emotion : why you feel the way you feel*. New York, NY: Scribner.

Pike, J. L., Smith, T. L., Hauger, R. L., Nicassio, P. M., Patterson, T. L., McClintick, J., et al. (1997). Chronic life stress alters sympathetic, neuroendocrine, and immune responsivity to an acute psychological stressor in humans. *Psychosom Med, 59*(4), 447-457.

Rabineau, K. M., Treiber, F. A., Poole, J., & Ludwig, D. (2005). Interactive effects of anger expression and ET-1 Lys198Asn polymorphism on vasoconstriction reactivity to behavioral stress. *Ann Behav Med, 30*(1), 85-89.

Ramirez, L. M., Ballesteros, L. E., & Sandoval, G. P. (2007). Tensor tympani muscle: strange chewing muscle. *Med Oral Patol Oral Cir Bucal, 12*(2), E96-100.

Ravosa, M. J., Kunwar, R., Stock, S. R., & Stack, M. S. (2007). Pushing the limit: masticatory stress and adaptive plasticity in mammalian craniomandibular joints. *J Exp Biol, 210*(Pt 4), 628-641.

Rugh, J. D., Woods, B. J., & Dahlstrom, L. (1993). Temporomandibular disorders: assessment of psychological factors. *Adv Dent Res, 7*(2), 127-136.

Selye, H. (1978). *The stress of life* (Rev. ed.). New York: McGraw-Hill.

Sogyal, G., Patrick Harvey, Andrew. (2002). *The Tibetan book of living and dying* (Rev. and updated ed.). [San Francisco, Calif.]: HarperSanFrancisco.

Truelove, E., Huggins, K. H., Mancl, L., & Dworkin, S. F. (2006). The efficacy of traditional, low-cost and nonsplint therapies for temporomandibular disorder: a randomized controlled trial. *J Am Dent Assoc, 137*(8), 1099-1107; quiz 1169.

Zverev, E. V., & Remizov, V. G. (2007). *The role of lacunar-canalicular system of the bone in creation of osteopathic lesion* (1st ed.). St. Petersburg, Yaroslavl: Sky 7.