Myofascial Pain and Dysfunction: A Scientific Approach to a Clinical Enigma

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INTRODUCTION

Dental clinicians are showing considerable interest in the problem of myofascial pain and dysfunction (MPD) in the musculature of the head and neck. Certainly, dentists must involve themselves in this area, as dentistry is responsible for more than the dentition. We are aware that the primary goal of dentistry today is in the maintenance and treatment of the entire oral apparatus, including the muscles of mastication and the temporomandibular joints. We see that particularly in the area of MPD, simplistic therapeutic solutions elude us. Along with that, patient responses are not always predictable. Practitioners faced with the challenges of daily patient need have thus far been forced to provide treatment modalities some of which have not yet been scientifically substantiated. The clinician who courageously attempts to resolve muscle pain will benefit from an understanding of the research approach in order to comprehend the scope of the problem and the limitations of individual treatment modalities.

Hyperactivity in the elevator muscles, primarily in the masseter, temporalis, and medial pterygoid, can cause symptoms of pain and interference or restriction of mandibular movement. Consequently, the purpose of this paper is to review the subject of masticatory elevator muscle hyperactivity from a research standpoint, applying that information to specific treatment approaches in clinical practice.

Mandibular resting state

Resting activity of the elevator muscles has been studied by many investigators. Because of the advent of electromyographic (EMG) techniques, it is now accepted that skeletal muscle at rest shows minimal electrical activity. There is a range of position variability whereby the muscles of mastication will maintain their resting state. Therefore, a postural position of the mandible with the muscles at rest may be found to...
be within a range or area, not at one irrevocable position. For the clinician, this information is directly applicable to patient approach in determining mandibular position when necessary. According to this research, the musculature will allow some variability in mandibular placement.

**Hyperactivity**

Hyperactivity of the elevator muscles is commonly observed in patients who complain of mandibular pain and dysfunction. This activity is a result of excitation of the neuromuscular system by two possible sources: Receptors in and around the oral cavity or stimulation more centrally from the nervous system.

**LOCAL RECEPTORS**

The oral receptors, when stimulated, provide afferent input to increase jaw muscle activity. It has been speculated that this input may initiate a prolonged reflex increase in elevator muscle activity. There are three types of receptors which are currently under investigation by neuromuscular researchers. They are the periodontal ligament mechanoreceptors, the temporomandibular joint receptors and the muscle spindles.

**PDL mechanoreceptors**

Periodontal ligament (PDL) receptors are located within the periodontal ligament surrounding the teeth. When a tooth is stimulated, the mechanoreceptor within the ligament is also stimulated. This causes an afferent impulse to discharge to the CNS which then sends an efferent message to cause a reflex response in the masticatory muscles. The stimulation to the tooth may be as gentle as a brush stroke or as forceful as heavy masticatory stresses. These PDL receptors also exhibit directional sensitivities with variation of response. Some will discharge spontaneously, some respond only if the stimulus is very rapid, some produce one or two impulses after stimulation, while others will produce a continuous discharge.²

Because the fibers of the PDL mechanoreceptors are intermingled with branches of the trigeminal nerve, it has been difficult to conduct studies on exactly what influence PDL stimulation has on the elevator muscles. Their principle action is that their stimulation will cause a jaw-opening reflex by excitation of the jaw opening muscles.³ That is the opposite effect one might suspect in the investigation of the PDL mechanoreceptors as stimulators of the jaw elevator musculature. Also, practitioners tend to believe that equilibration of the teeth and distribution of occlusal forces will relieve the symptoms associated with hyperactivity of the elevator muscles.⁴
In order to attempt to substantiate these clinical theories, investigators have experimented with various interferences in occlusions and observed elevator muscle activity. One such study was conducted by Rugh, et al. A deflective interference (0.5–1 mm forward and lateral) was placed in the occlusion of 10 subjects (5 female, 5 male) who were then monitored for masseter activity during a 10–21 night period. Nine subjects showed a decrease in elevator muscle activity on the first few nights, with 5 showing a decrease the entire period. Only one subject showed an increase in bruxing activity. The conclusion of these investigators was that they could not substantiate the theory that occlusal interferences were a cause of hyperactivity of the elevator muscles. There are, however, other reports. Lavigne, et al. experimenting with cats, concluded that periodontal mechanoreceptors are responsible for increases in cycle duration of elevator muscle activity. Also, because of the individuality of the different PD receptors, it may be possible that only certain types of occlusal interferences will initiate a hyperactive response.

Consequently, at this time, there is a need for more extensive investigation on the research level to show what effects stimulation of the PDL mechanoreceptors have on the elevator muscles. This lack of scientific substantiation for the clinicians' therapeutic attempts, e.g., equilibration, to alleviate elevator muscle pain and/or hyperactivity, may act as a message to the clinician that it is not possible at this time to provide predictable results in this area of patient treatment. There is no valid scientific evidence at this time to justify equilibration as the sole treatment modality for reducing masticatory muscle activity, or to remotely suggest that malocclusion is a predominant etiology of MPD.

TMJ receptors
Temporomandibular joint mechanoreceptors have been described as mostly free nerve endings which are present in large numbers throughout the joint capsule. There are also more complex receptors called "Ruffini receptors" in the lateral aspect of the capsule. Experiments on cats revealed that there is an influence on jaw muscle motor neuron excitability by these TMJ receptors. When the joint moves in a closing direction, elevator muscle activity is inhibited, while opening movements subject the same elevator muscles to excitatory effects. Clinicians considering procedures designed to reposition the mandible may find this information useful. If an excitable response in these muscles is anticipated, therapeutic measures such as physical therapy may be initiated routinely. Studies have also suggested, however, that there may be adaptation by these TM receptors over time, modifying their response to that new condylar position.
Muscle spindles
The spindle arrangements within muscle are comparable to mechanoreceptors. They are stimulated when the muscle is stretched, causing a reflex contraction of that muscle. The spindle afferents have their cell bodies located within the trigeminal mesencephalic nucleus. When a stimulus stretches the muscle, a reflexive contraction occurs. This is exemplified best by the jaw-jerk reflex. That response is, however, momentary. A vibrational stimulus will provoke a maintained response. There are no reports of how peripheral stimulation could lead to a maintained activity of the elevator muscles without concurrent activation of the gamma motor system from higher centers.

According to Yemm, central factors may be viewed in four parameters: habitual activity, hyperactivity in chewing, stress induced muscle activity, and nocturnal hyperactivity.

Habitual activity
The muscles of normal subjects are inactive unless that person is chewing, swallowing, or speaking. Some individuals, however, position their jaws in such a way as to attempt to correct for facial morphology. Orthodontists have studied this area extensively. An example of this behavior can occur with patients who have a Class II deformity. These individuals will maintain a protruded posture of the mandible in order to create a more esthetic appearance. This will activate the lateral pterygoid muscles, possibly fatiguing them over long periods of time. Other habitual activities are liplicking and gum chewing.

Hyperactivity in chewing
The chewing process is an extremely complex coordination of many muscles. Their activity must be integrated even down to the level of the motor unit. In 1977 Yemm reported that even in a restricted region of the masseter muscle, motor units exhibited a tendency to discharge more readily in association with movements in a particular direction.

Because occlusal morphology plays a part in determining the precise pattern of movement on chewing, the demands on different muscles and on the individual motor units changes with change in the occlusion.

Stress induced muscle activity
Many studies have supported the theory of stress-induced muscle activity. In a 1971 study by Yemm, the human subjects were
given a task to perform with a high degree of difficulty while electrical activity of the elevator muscles was recorded. The results showed a relationship between the difficulty of the task and the magnitude of the response.

Perry, et al., in 1960 placed dental students in a stressful interview situation. He demonstrated increases in masseter and temporalis muscle activity. These subjects also reported that they tended to clench their teeth during that time. Lundgren and Olsson (1977) produced a facilitation of the monosynaptic jaw closing reflex of the masseter muscle in the cat by electrically stimulating its hypothalamus, the area known as the defense-attack region. These studies favor the psychophysiologic theory of myofascial pain which proposes that central effects (state of mind or attitudes) may be directly related to elevator muscle activity.

Nocturnal hyperactivity
This bruxism phenomena tends to be tied in with the various sleep cycles, especially during the REM period when one dreams. Studies have also shown that amphetamine administration will increase the incidence of nocturnal bruxism. Bruxism and tooth wear has been commonly shown in children with brain damage. These studies indicate a central mechanism for this behavior.

Dental clinicians who treat patients with myofascial pain have begun referring many of these patients to stress-therapists. Some practitioners provide psychological testing along with history taking before initiating any therapy in order to screen for emotional problems.

GUIDELINES FOR TREATMENT

The Presidents Conference on the Examination, Diagnosis, and Management of Temporomandibular Disorders in 1982 reviewed much of the preceding information. It presented a statement on guidelines for the examination, diagnosis, and management of TM disorders. Concerning guidelines for treatment, it concluded that “at present there is insufficient data to permit comparison of different forms of therapy to establish a priority for their use. However, the basic principle of using conservative reversible forms of therapy, whenever possible, was advocated.” Physical therapy, occlusal appliances, and pharmacologic agents were considered as reversible therapies. Occlusal adjustments, as well as surgery and mandibular repositioning, were presented as irreversible modes of therapy.
CONCLUSION

Current research indicates that central effects are as, if not more, influential than local effects in maintaining hyperactivity in the elevator muscles. The clinician who understands this concept is better equipped to provide a variety of therapies to these MPD patients. It is therefore imperative for practitioners to continue to educate themselves about this complex problem. Until research provides the profession with substantial support for therapeutic regime, clinicians are requested to consider utilizing reversible forms of therapy to alleviate patient symptoms.

REFERENCES


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