

IN SUPPORT OF THE EFFICACY OF EMG

Surface electromyography (EMG) has been employed by researchers (120 studies) and clinicians (2000+ in the U.S.) for over twenty years. It is the only quantitative method to measure and document the severity, progression, and treatment of muscle dysfunction in the craniomandibular patient.

Over forty dental schools world-wide have produced over 120 studies...all validating two central facts about muscle activity:

1. Patients with craniomandibular dysfunction have distinctly different patterns of muscle activity (at rest, in clench, while chewing, and while speaking) than the asymptomatic "normal" subject. So EMG clearly confirms and quantifies the presence and severity of this muscle dysfunction.
2. Successful treatment reduces the irregularity and severity of muscle dysfunction. So comparison of post-treatment muscle activity with pre-treatment baseline documents treatment efficacy.

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ANNOTATED BIBLIOGRAPHY IN SUPPORT OF ELECTROMYOGRAPHY (EMG)

American Academy of Craniomandibular Disorders - Guidelines for Evaluation, Diagnosis and Management Quintessence Publishing, 1990

Continuous muscle contraction, measured by **increased electromyogram activity**, even at rest, is **an important diagnostic criteria of spasm**. And postural hypertonicity of the muscles is a diagnostic criteria for **myofascial pain**.

- 103 *Burdette, B.H., Gale, E.N.: The Effects of Treatment on Masticatory Muscle Activity and Mandibular Posture in Myofascial Pain-Dysfunction Patients. J Dent Res 1988 67:1126-1130.*

Pre-treatment EMG values of both masseteric and anterior temporal areas were **significantly higher for the MPD group than for the control group**, while a lowering of tonic resting EMG activity alone does not appear to be sufficient to ensure successful therapy for MPD pain.

- Burgess, J.A., Sommers, E.E., Truelove, E.L., Dworkin, S.F.: Short-Term Effect of Two Therapeutic Methods on Myofascial Pain and Dysfunction of the Masticatory System. J Prosthet Dent 1988;60:606-610.*

EMG was used to evaluate the effect of muscle chilling with ethyl chloride and intervention through reflexive inhibition. In general, **EMG levels were observed to decrease for treatment subjects.**

- Chaco, J.: Electromyography of the Masseter Muscles in Costen's Syndrome. J Oral Med 1973;28:45-46.*

Electromyographic (EMG) recordings were taken on myofascial pain patients before and after administration of diazapan. **The administration of the drug resulted in normal EMG recordings and relief of pain.**

- 112 *Chong-Shan, S.: Proportionality of Mean Voltage of Masseter Muscle to Maximum Bite Force Applied for Diagnosing Temporomandibular Joint Disturbance Syndrome. J Prosthet Dent 1989;62:682-684.*

Using electromyography, maximum bite force was evaluated in TMD patients and controls. Results indicate **masticatory muscles of patients of TM dysfunction are in a state of hyperactivity and tension.**

- Clark, G.T., Beemsterboer, P.L., Solberg, W.K., Rugh, J.D.: Nocturnal Electromyographic Evaluation of Myofascial Pain Dysfunction in Patients Undergoing Occlusal Splint Therapy. J Am Dent Assoc 1981, 99:607-611.*

Level of nocturnal masseter activity was evaluated in patients with myofascial pain and controls. **A significant positive correlation was demonstrated between EMG level and symptom severity.** There was also significant positive correlation between EMG level, tooth wear, and severity of symptoms.

Clark, G.T., Seligman, D.A., Solberg, W.K., Pullinger, A.G.: *Guidelines for the Examination and Diagnosis of Temporomandibular Disorders. J Craniomandib Disord Facial Oral Pain* 1989 3:7-14.

True muscle spasm can be differentiated from protective splinting and trismus by clinical inspection and electromyographic verification of sustained involuntary muscle contraction at rest.

129 Cooper, B.C., Cooper, D.L., and Lucente, F.E. *Electromyography of Masticatory Muscles in Craniomandibular Disorders. Laryngoscope* 101, February, 1991.

In 641 craniomandibular patients, hyperactive resting EMG levels were significantly reduced through transcutaneous electrical neural stimulation therapy. And after occlusal repositioning with an orthotic appliance, the EMG showed an increase in maximum muscle activity function and in coordination of muscle groups during mandibular movement. Thus, **clinical electromyographical studies are an important aid in the treatment of craniomandibular disorders.**

Dahlstrom, L., Carlsson, S.G., Gale, E.N., Jansson, T.G.: *Stress-Induced Muscular Activity in Mandibular Dysfunction: Effects of Biofeedback Training. J Behav Med* 1985 8:191-200.

Initially recorded EMG activity of the temporal muscle in the rest position was correlated with signs of dysfunction. Compared to previously studied healthy subjects, **the patients had lower EMG activity in the recorded muscles during maximal biting.**

107 Dahlstrom, L.: *Electromyographic Studies of Craniomandibular Disorders: A Review of the Literature. J Oral Rehabil* 1989;16:1-20.

The studies of basic EMG activity consistently show an increased rest activity in investigated muscles, masseter and temporal, when recorded in groups of patients with CMD symptomatic at the time of examination. The average level of activity during maximum biting seems to be less in patients compared to healthy subjects and certain findings may be interpreted as muscle fatigue. The frequency, intensity, and/or duration of masticatory muscle activity appeared definitely to be greater in symptomatic patients than in health controls.

Dohrmann, R.J., Laskin, D.M.: *An Evaluation of Electromyographic Biofeedback in the Treatment of Myofascial Pain-Dysfunction. J Am Dent Assoc* 1978;96:656-662.

In patients treated (or not treated) with EMG biofeedback, there were **significantly higher mean EMG levels than for a control group**. Those receiving biofeedback were able to reduce their masseter EMG levels significantly, with concurrent reduction of symptoms.

Fuchs, P.: The Muscular Activity of the Chewing Apparatus During Night Sleep. J Oral Rehab 1975;2,35.

Investigated masticatory muscle activity using EMG during sleep.
Dysfunctional patients had higher muscular activity during sleep than healthy persons.

Garret, N., et.al.: Effects of Denture Modification on Muscle Effort Across Masticatory Strokes. IADR Abstract 1691, 1991.

EMG was used to assess chewing efficiency after improvements in occlusion and fit of existing poorly fitting dentures or insertion of new dentures. There was a **reduction in masseter muscle effort and an improvement in masticatory function validated by EMG following denture improvement.**

115 *Gervais, R., Fitzsimmons G.W., Thomas, N.R.: Masseter and Temporalis Electromyographic Activity in Asymptomatic, Subclinical, and Temporomandibular Joint Dysfunction Patients. Journal of Craniomandibular Practice 1989;7:52-57.*

Resting EMG levels were obtained from masseter and temporalis in asymptomatic, subclinical, and patient groups. Patient group demonstrated significantly higher EMG activity than the asymptomatic or subclinical groups. Temporalis was found to be a site of greatest EMG activity more frequently than the masseter. These findings strengthen diagnostic and assessment procedures and criteria. EMG resting levels were determined for patients and controls for frontalis, temporalis, and masseter muscles. **For each muscle, EMG activity was significantly higher for the MPD group than for controls.**

Isberg-Holm, A., Widmalm, S.-E., & Ivarsson, R.: Clinical, Radiographic, and Electromyographic Study of Patients with Internal Derangements of the Temporomandibular Joint. Am J Orthod 1985; 88:453-460.

Together with clinical and radiographic examination, **EMG recordings of the masseter and temporalis muscles** were obtained in patients with anterior disk displacement and healthy subjects. In the patient group, EMG activity occurred

when the condyle slid over the disk. It was concluded that **masticatory muscle activity could be provoked by disk displacement which ceased when the disk position was normalized on mouth opening.**

Kohno, S., Bando, E., Tanaka, B., Tabata, T.: Estimation of Occlusal Position from Masticatory Muscle Activity, in Kawamura, Y., Dubner, R. (eds); Oral-Facial Sensory and Motor Functions, Chicago, Quintessence Publ Co., 1981, pp. 133-41.

The study evaluated the data relationship between jaw position and the function of jaw muscles. The conclusion was that the **occlusal positions of the mandible on any subject can be estimated with high accuracy solely from the activity of the masticatory muscles, utilizing EMG patterns.**

Lous, I., Sheikholeslam, A., Moller, E.: Postural Activity in Subjects with Functional Disorders of the Chewing Apparatus. Scand J Dent Res 1970;78:404-410.

Patients with functional disorders of the temporomandibular joint and the muscles of mastication were compared with controls to assess activity in the temporal and masseter muscles using EMG. **On the average, the level of postural activity in the patient was significantly higher than the control group.**

Manns, A. Miralles, R. Guerrero, F.: The Changes in Electrical Activity of the Postural Muscles of the Mandible Upon Varying the Vertical Dimension. J Prosthet Dent 1981;45:438-455.

Masseteric EMG activity was monitored to assess the influence of splints with varying vertical dimension in patients with mandibular dysfunction. **A significant reduction of masseter EMG activity in patients with thicker splints was noted.**

Mercuri, L.G., Olson, R.E., Laskin, D.M.: The Specificity of Response to Experimental Stress in Patients with Myofascial Pain Dysfunction Syndrome. J Dent Res 1979 58:1866-1871.

Electromyographic studies measuring localized muscle tension in facial pain patients support an **association between increased EMG activity and muscle pain.**

- 117 Miller, A.J., Nielsen, I.L.: *Neuromuscular Compensation in Subjects with Craniomandibular Disorders. EMG of Jaw Reflexes in Man, 1989, Leuven University Press.*

Subjects with muscle pain and tenderness demonstrate five neuromuscular characteristics of the jaw closing muscles as determined by EMG studies with 1) increased postural activity of the jaw closing muscles; 2) less electromyographic activity during maximal contraction such as during clenching; 3) increased duration of masticatory discharge; 4) increased masseter muscle activity during night bruxism; and 5) spastic discharge of the ipsilateral temporalis muscles when a subject attempts to move the jaw over the disk without reduction.

- 110 Myslinski, N.R., Buxbaum, J.D., and Parente, F.J.: *The Use of Electromyography to Quantify Muscle Pain. Meth and Find Exptl Clin Pharmacol, 1985: 7(10):551-556.*

This study was designed to determine feasibility of using EMG to quantify muscle pain in patients suffering from chronic myofascial pain dysfunction. Measurements of perceived pain and EMG frequency and amplitude were recorded before and after standard analgesic therapy. The highest correlation between EMG recordings and subjective pain ratings were demonstrated in the resting mode. **A significant relationship exists between the change in perceived pain and the EMG levels.**

- 109 Naeije, M., Hansson, T.L.: *Electromyographic Screening of Myogenous and Arthrogenous TMJ Dysfunction Patients. J Oral Rehabil 1986;13:433-41*

The TMJ dysfunction pain of 40 patients was evaluated to be of a myogenous origin or arthrogenous. Patients were asked to clench. Surface electromyograms were taken of their masseters and anterior temporalis. **Statistically significant differences between two patient groups were found in EMG amplitude.**

- Nakamura, T., Inoue, T., Ishigaki, S., Maruyama, T.: *The Effect of Vertical Dimension Change on Mandibular Movements and Muscle Activity. Int J Pros 1988;1:297-301.*

Significant changes were observed in the EMG activity of the masseter and digastric muscles in some ten subjects as the vertical dimension of occlusion was altered using three different acrylic resin occlusal devices.

- 105 *Nielsen, I.L., McNeill, C., Danzig, W., Goldman, S., Levy, J., and Miller, A.J.: Adaptation of Craniocfacial Muscles in Subjects with Craniomandibular Disorders. Am J Orthod Dentofac Orthop, January 1990, p.20-34.*

Surface EMG recordings were taken on 43 subjects with pain in the craniomandibular muscles and 17 controls. The results show that the subjects with muscle pain use their anterior temporalis muscles with less frequency and with less intensity in several responses than normal subjects. Bilateral activity demonstrates that **subjects with muscle pain have a more severe asymmetrical recruitment of these muscles than the more symmetrical recruitment seen in normal subjects.** Muscle pain clearly altered the recruitment of their jaw muscles, supporting the concept that the **neuromuscular system is altered in patients with craniomandibular disorders.**

- Pasero, F., et.al. Clinical Signs of TMJ Arthritis and Masseteric Maximal EMG Recording. IADR Abstract 516, 1991.*

EMG activity was compared for subjects exhibiting mild, moderate, severe or no arthropathy. **A significant decrease in maximal clenching activity, demonstrated through EMG, was demonstrated in patients with severe arthropathy.** Severe clinical signs of TMJ arthritis are associated with the decrease in jaw closing muscles performance. **Hypo function is a constant electromyographic sign of TMJ arthritis at advanced stages.**

- Ramfjord, S.P.: Bruxism: A Clinical and Electromyographic Study. J Amer Dent Assoc 1961a;62:21-44.*

Investigated the relationship between occlusal disharmony, bruxism and pain in stomatognathic system under various functional conditions. Increased activity was initially commonly recorded from posterior temporalis muscle at rest. **During swallowing all patients exhibited a disturbed EMG pattern. After occlusal adjustment normal muscle activity and complete relief of symptoms were attained in all patients.**

- 113 *Sheikholeslam, A., Moller, E., Lous, I.: Postural and Maximal Activity in Elevators of Mandible Before and After Treatment of Functional Disorders. Scand J Dent Res 1982;90:37-46.*

In a longitudinal study, clinical data on pain, tenderness, and EMG recordings of postural, maximal activity recorded before and after treatment in 37 patients. Forty-three dental students served as controls. **Treatment was followed by a decrease in pain, tenderness and EMG postural activity.** Duration of the right and left temporalis muscles also became more uniform.

Shiga, H., et al: *Change in EMG Power Spectra during Clenching in CMD Patients. IADR Abstract 1971, 1991.*

EMG power spectra has been widely used to study function of masticatory muscles. In this research the use of EMG spectral analysis to diagnose craniomandibular disorders was explored. Mean EMG frequency of the patient group was significantly larger than the normal group. The authors suggest that **EMG power spectra can be used as a tool in differential diagnosis of CMD.**

Trott, P.H., Goss, A.N.: *Physiotherapy and Diagnosis and Treatment of Myofascial Pain Dysfunction Syndrome. Int J Oral Surg 1978;7:360-5.*

Cold stretching and reflexive inhibition therapy used in combination with other therapeutic modalities reduced muscle tension evident in **reduced levels of electromyographic (EMG) activity.**

116 VanBoxtel, A., Goudswaard, P., Janssen, K.: *Absolute and Proportional Resting EMG Levels in Muscle Contraction and Migraine Headache Patients. Headache, 1983;23:215-222.*

In this study, **resting EMG levels** were measured for frontalis and temporalis muscles in patients suffering from muscle contraction, headaches, migraine, or mixed muscle contractions/migraine headache. **Significantly higher levels were found in the headache groups.** Resting EMG levels were expressed as a percentage of EMG level during maximal contraction. And headache patients generally showed lower maximal EMG levels than control subjects.

ADDITIONAL RESEARCH IN SUPPORT OF EMG

Ash, M.M.: *Current Concepts in the Aetiology, Diagnosis and Treatment of TMJ and Muscle Dysfunction. J Oral Rehabil 1986;13:1-20.*

Arroyo, P.: *Electromyography in the Evaluation of Reflex Muscle Spasm. J Fla Med Assoc 1966;53:29-31.*

Bakke, M., Moller, E.: *Distortion of Maximal Elevator Activity by Unilateral Premature Tooth Contact. Scand J Dent Res 1980;80:67-75*

Bakke, M., Michler, L., Han, K., Moller, E.: *Clinical Significance of Isometric Bit Force Versus Electrical Activity in Temporal and Masseter Muscles. Scand J. Dent Res 1989;97:539-51.*

Boyd, D.C., Bratty, P., Lawrence, P.D.: *A Review of the Methods of Automatic Analysis in Clinical Electromyography. Comput Biol Med 1976;6:179-190.*

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