STUDIES SUPPORTING THE EFFICACY OF NEUROMUSCULAR DENTISTRY AND NM OCCLUSION

There is a vast body of literature supporting the science of neuromuscular dentistry and neuromuscular occlusion. The following is a partial list of studies that investigate patient population's response to NM treatment. These articles published in refereed journals document the efficacy of neuromuscular principles in the evaluation and treatment of malocclusion.

1) Cooper, Barry C. (1997) The role of bioelectric instrumentation in the documentation of management of temporomandibular disorders. ***Oral Surg Oral Med Oral Pathol Oral Radiol Endod*** **83:1, pp 91-100**

Otolaryngology Department Manhattan Eye, Ear & Throat Hospital

Summary: Temporomandibular disorders (TMDs) can affect the form and function of the temporomandibular joint, masticatory muscles and dental apparatus. Electronic measurement of mandibular movement and masticatory muscle function provides objective data that are defined by commonly accepted parameters in patients with TMDs; these data can then be used to design and monitor therapy and enhance treatment therapy. In this study, data on 3681 patients with TMD are presented, including electronic test data on 1182 treated patients with TMDs. Electronic jaw tracking was used to record mandibular movement and to compare the presenting and therapeutic dental occlusal positions.

Electromyography was used to analyze the resting status of masticatory muscles and occlusal function at presentation and after therapeutic intervention. Transcutaneous electrical nerve stimulation therapy relaxed masticatory muscles and aided in the determination of a therapeutic occlusal position. The data show a positive correlation between the clinical symptoms of TMD and the presenting occlusion, accompanied by muscle activity. A strong positive correlation also appears to exist between a therapeutic change in the dental occlusion to a neuromuscularly healthy position with use of a precision orthotic appliance and the significant relief of symptoms within 1 month and at 3 months.

2) Hickman, D.M., Cramer, R. ***The effect of different condylar positions on masticatory muscle electromyographic activity in humans.*** **Oral Surg Oral Med Oral Pathol Oral Radiol Endod. 1998 Jul;86(1):2-3.**

West Virginia University Health Sciences Center North, Morgantown, USA.

Objectives: The purpose of this study was to determine a condylar position that permitted the greatest total temporalis and masseter muscle activity in maximum static clench. Study Design: Twenty normal adults, 9 women and 11 men, were evaluated to determine masseter and temporalis activity in maximum static clench with mandibular condyles in different therapeutic positions. Bimanually manipulated, leaf gauge, centric occlusion,

and neuromuscular condylar positions were studied. Results: When mandibular condyles were placed anteroinferiorly in a neuromuscular position, total masticatory muscle recruitment was the greatest. In a bimanually manipulated or a leaf gauge position, mandibular condyles were positioned superoposteriorly, producing the least amount of muscle recruitment. Conclusions: The result of any therapeutic position should be an improvement in muscle function. With respect to balance and activation, a neuromuscular condylar position proved to be the position capable of recruiting the greatest motor unit activity when compared with a bimanually manipulated position, a leaf gauge position, and a neuromuscular position.

3) Hickman, David, M., Cramer, Richard, Stauber, William T. (1993) The effect of four jaw relations on electromyographic activity in human masticatory muscles. *Archs Oral Biol* 38:3, pp 261-264.

School of Dentistry and Departments of Physiology and Neurology, West Virginia University Health Sciences Center North, Morgantown, WV.

Summary: Significant differences were found in the electromyographic (EMG) activation between the masseter and temporalis muscles for the leaf gauge (LG), manually manipulated (CR) and neuromuscular (NM) bite positions during maximal static clench. The LG position consistently demonstrated the lowest EMG activity, while the NM position displayed the highest degree of muscle activity. Similarly, the ratio of the masseter/temporalis EMG activity during maximal clench was lower for the LG and CR positions and highest for the NM position. These data indicate that the NM position produced the greatest total muscle recruitment, with more masseter involvement during maximal clench, and enabled the subjects to generate greater clenching forces in the NM position as compared to the LG and CR positions.

4) Lynn, Jack M., Mazzocco, Mike W., Miloser, Stephen J., Zullo, Thomas, (1992) Diagnosis and Treatment of Craniocervical Pain and Headache based on Neuromuscular Parameters, *American Journal of Pain Management,* 2:3, pp 143-151.

Summary: There is increasing evidence supporting the premise that hypertonicity within facial muscles is an etiologic factor for some chronic headache patients. This muscular hypertonicity is the result of neuromuscular imbalances within the head and neck. Through the analysis of electromyograph (EMG) data, it is possible to construct an intraoral orthosis which creates neuromuscular balance and subsequently relieves the pain.

This study attempted to identify (i) the relationship of EMG-measured dysfunction to reported craniocervical pain and (ii) the effectiveness of EMG-based orthoses on reversing myospastic conditions. Results of the study (N=203) indicate a significant ($p<.0001$) decrease in muscular myospasm at rest and a significant ($p<.0001$) increase in muscular activity during function following treatment with EMG-based orthoses. Reported craniocervical pain was significantly reduced. Results of this study support the

hypothesis that creation of a physiologic neuromuscular envelope of craniocervical motion allows reduction of muscular hypertonicity resulting in reduction of pain. Furthermore, utilization of electromyography is a valuable tool during assessment and treatment of chronic facial pain patients.

5) Coy, Richard E., Flocken, John E., Adib, Fray (1991) Musculoskeletal Etiology and Therapy of Craniomandibular Pain and Dysfunction. *Cranio Clinics Intl*, Williams and Wilkens, Baltimore, pp 163-173.

Summary: The investigators sent questionnaires and guidelines for submission of case histories to Fellows of the International College of Craniomandibular Orthopedics, who are geographically dispersed over the United States. The practitioners were requested to supply data and case histories on patients who were treated specifically for Craniomandibular pain or dysfunction. Sixty-eight case histories received from 20 practitioners that met the study guidelines were included.

Electronically derived measurement provides an objective quantitative database for diagnosing the existence and extent of myostatic contracture and skeletal malrelation. Compilation of the electronically derived data, correlated with the subjective evaluations of both patient and therapist, establish the existence of significant skeletal malrelation of the mandible to the cranium and consequent myostatic contracture in the pain and dysfunction population. The data reported in these case histories indicate that a common measurable etiology is responsible for the many ostensibly diverse manifestations of craniomandibular pain and dysfunction. The diagnostic validity and usefulness of the electronically derived quantitative data are supported by the correlative subjective perception by the patient of alleviation of symptoms in response to the correction of skeletal malrelation and the consequent reduction of muscle tension (table 7). The course of treatment provides rapid initial palliation followed by long-term resolution as a result of orthopedic correction of skeletal malrelation.

The data clearly established that in the patient population under study:

1. The average electromyograph activity with the patient at rest decreased substantially in the left and right anterior temporalis and masseter muscles after treatment.
2. The average electromyograph activity with the patient clenching increased substantially in the left and right anterior temporalis and masseter muscles after treatment.
3. Following the orthopedic correction of skeletal malrelation, over half of the patients had complete alleviation of symptoms, with the remaining patients experiencing a substantial reduction in the number of their symptoms.

The continuing positive responses to this noninvasive treatment based on quantitative as well as subjective diagnosis indicate the need in every case of craniomandibular pain or dysfunction to rule in or rule out musculoskeletal dysfunction as the most common underlying etiologic factor in most aspects of craniomandibular pain and dysfunction.

In cases in which the data rule out existing musculoskeletal dysfunction as a possible etiology, the patient may then be referred to other appropriate specialties such as neurology, otolaryngology, orthopedics, or psychiatry with the assurance to that specialty that the etiologic possibility of musculoskeletal dysfunction has been explored and ruled out.

6) Cooper, BC, Kleinberg, I, Establishment of a temporomandibular physiological state with neuromuscular orthosis treatment affects reduction of TMD symptoms in 313 patients. J. Craniomandibular Practice, 2008; 26(2) 104-115

SUMMARY - The objective of this investigation was to test the hypothesis that alteration of the occlusions of patients suffering from temporomandibular disorders (TMD) to one that is neuromuscularly, rather than anatomically based, would result in reduction or resolution of symptoms that characterize the TMD condition. This hypothesis was proven correct in the present study, where 313 patients with TMD symptoms were examined for neuromuscular dysfunction, using several electronic instruments before and after treatment intervention. Such instrumentation enabled electromyographic (EMG) measurement of the activities of the masticatory muscles during rest and in function, tracking and assessment of various movements of the mandible, and listening for noises made by the TMJ during movement of the mandible. Ultra low frequency and low amplitude, transcutaneous electrical neural stimulation (TENS) of the mandibular division of the trigeminal nerve (V) was used to relax the masticatory muscles and to facilitate location of a physiological rest position for the mandible. TENS also made it possible to select positions of the mandible that were most relaxed above and anterior to the rest position when the mandible was moved in an arc that began at rest position. Once identified, the neuromuscular occlusal position was recorded in the form of a bite registration, which was subsequently used to fabricate a removable mandibular orthotic appliance that could be worn continuously by the patient. Such a device facilitated retention and stabilization of the mandible in its new-found physiological position, which was confirmed by follow up testing. Three months of full-time appliance usage showed that the new therapeutic positions achieved remained intact and were associated with improved resting and functioning activities of the masticatory muscles. Patients reported overwhelming symptom relief, including reduction of headaches and other pain symptoms. Experts consider relief of symptoms as the gold standard for assessment of effectiveness of TMD treatment. It is evident that this outcome has been achieved in this study and that taking patients from a less to a more physiological state is an effective means for reducing or eliminating TMD symptoms, especially those related to pain, most notably, headaches.