



Gneuromuscular Dentistry – a new paradigm

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Abstract

Gneuromuscular dentistry is an evolving treatment concept that focuses on the relationship between the teeth, jaw, and muscles of the head and neck. It involves using specialized techniques derived from the concepts of Gnathology and Neuromuscular Dentistry to diagnose and treat conditions related to the temporomandibular joint (TMJ), which connects the jawbone to the skull. The goal of gneuromuscular dentistry is to achieve optimal alignment of the teeth, jaw, and muscles to improve overall oral health and function. This can help alleviate symptoms associated with TMJ disorders, such as headaches, jaw pain, clicking or popping of the jaw, and ringing in the ears. Gneuromuscular dentistry involves a comprehensive evaluation of the patient's bite, jaw position, and muscle activity using advanced technology such as electromyography (EMG) and computerized mandibular scanning. Treatment may include orthodontics, restorative dentistry, and/or the use of a custom-made oral appliance to help reposition the jaw and relieve muscle tension. This article will explore the principles of gneuromuscular dentistry, its evolution, benefits, and the techniques used to achieve optimal alignment of the teeth, jaw, and muscles.

Keywords: Gneuromuscular dentistry, Gnathology, Neuromuscular Dentistry, Temporomandibular disorders (TMDs)

DOI Number: 10.48047/nq.2023.21.5.NQ222084

NeuroQuantology2023;21(5):907-915

Introduction

Improvement of health and returning the body to the state of optimal health is the goal of any treatment or therapeutic regimen. The stomatognathic system is composed of three major entities: the teeth, Temporomandibular joint (TMJ) and muscles. All the three entities must function together harmoniously to allow the teeth to interdigitate into a defined intercuspal position while the TMJ and muscles assist in jaw movement. Dental occlusion is modified when there is pain, masticatory dysfunction or

temporomandibular joint derangement. Abnormal form and function of the masticatory system will alter, displace and reposition the underlying bony and condylar structures to accommodate a malpositioned occlusion [1].

Treating craniomandibular disorders (CMD or TMD), is an area of dentistry that has often times frustrated the clinician due to its multi-faceted musculoskeletal occlusal signs and symptoms. An aspect that should be considered in this arena of treatment is the study of occlusion that relates the maxillary



and mandibular teeth as well as the temporomandibular joints and the mandible to the cranium. Investigating even further into this arena of occlusion, one discovers that it also involves physiologic dynamics of muscle activity and muscle rest that drives the masticatory element of occlusion. It is the supporting element that is often overlooked in the health care field that allows the human body to posture and optimally function as a complete healthy system. It is apparent after a more thorough understanding, diagnosis and evaluation by the dentist that musculoskeletal, postural, emotional, biochemical and/or functional issues may be part of the suffering patients complaints. Many of the symptoms that accompany this disorder continue to challenge the great minds of the dental profession who may not be aware that the signs and symptoms which are presented go beyond the occlusal perspective of how teeth articulate and where the centricity of condyle to glenoid fossa relationship exists.

Traditionally it was believed that these disorders can be treated through gnathological occlusal principles. However, there are fundamental differences between gnathological and neuromuscular approaches in therapy when addressing the needs of patients who present with the numerous signs and symptoms that compromise the craniomandibular dysfunctional patient [2].

Both Gnathological and Neuromuscular dentistry principles and protocols are systematically implemented and are now being recognized as Gneuromuscular (GNM) Dentistry [3]. According to traditional occlusal concepts, muscles will triumph over teeth when engaged in a tug of war, thereby creating adverse forces on the teeth and other structures within the masticatory system. Maintaining balance within the masticatory system requires an understanding of what is healthy and what is not. A keen awareness of physiology and pathology is essential to the diagnosis and effective treatment of any organ system. Muscles may place certain unseen demands on the temporomandibular joints (TMJ), teeth and

periodontium. As a result, teeth may develop wear facets, tooth mobility may occur and periodontal implications such as recession or even bone loss may occur. Many practitioners fail to realize that the muscles and TMJ may be the causes of dental issues and ignore the underlying factors that bring about these dysfunctions, albeit unintentionally. [3]. The current trend in the development of newer technologies in the form of both diagnostic aids and treatment modalities has opened up newer avenues. Extensive researchers have started uncovering the physiologic links between stomatognathic system and other systems of the body [4]. Modern research has proven that a scientifically executed reconstruction and rehabilitation of occlusion has a therapeutic effect on other important parameters such as posture, balance, muscle aches, headaches, etc.[5,6].

Sign and symptoms of occlusal disease and TMDs [3,7]

If the patient presents with any or more of the following signs and symptoms, we can assume that the patient is having a pathological occlusion.

1. Attrition, abrasion and erosion of teeth
2. Fractured cusps
3. Flared anterior teeth
4. Receding gums
5. Malocclusion
6. Tooth migration
7. Tooth hypermobility and cervical dentin hypersensitivity
8. Fremitus
9. Abfractions
10. Vertical bone loss or localized bone destruction
11. Pain and tired facial and masticatory muscles of temporomandibular joint (TMJ) pain
12. Sore and tired facial and masticatory muscles
13. Stiff neck, headache, facial pain, earache
14. Clicking on opening and closing mouth, limitation of jaw opening , deviation of the lower jaw either to right or left during mouth opening
15. Facial asymmetry
16. Forward head posture
17. Abnormal lip posture

18. Speech abnormalities

Role of Posture [7]

The issue of relationship between dental occlusion, body posture and temporomandibular disorders (TMDs) is a controversial topic in dentistry. Nonetheless, the role of dental occlusion in the development of TMDs cannot be overruled. The TMJ is directly related to the cervical and scapular region by an interrelated neuromuscular system. Changes in the cervical spine can cause TMJ disorders and the opposite is true. Studies have been carried out to confirm that postural changes of the head and the body could have an adverse biomechanical effect on the TMJ and lead to TMD. Alteration in masticatory muscles can be induced by changes in the head posture and vice versa. Therefore, the manipulation of the muscles of the mandible results in alterations in the usual head posture.

The association between dental occlusion and head posture has been investigated since early 1990s. Conflicting results have been obtained, some studies showed positive correlations between vertical occlusal dimension and head and cervical posture. Gait variations among individuals were observed in association with different mandibular positions, as well as malocclusions associated with abnormal posture. Moreover, other authors using a stabilometric footboard found that occlusal positions affect postural activity significantly. This paved way for further studies in this arena which reinforced the hypothesis that occlusion influences the head and neck posture and also on lumbar spine and leg posture. There is plethora of research that deal with the relationship between the characteristics of the body posture determined by rasterstereographic procedures and certain orofacial-orthopedic parameters. In a study by Lippold et al, for the examination of the dental features, no close correlation between the characteristics of the spine morphology and the overjet were found. The pelvic torsion, the facial axis and the facial depth, the vertical and the sagittal mandibular parameters were in close correlation with the body posture. Also

another study failed to reveal any close correlation between the mandibular position and the variables of the kyphotic and the lordotic angle or the pelvic inclination. Skeletal parameters like, the facial axis, the mandibular plane and the facial depth were among the parameters which showed a significant correlation with the degree of the cervical curvature. Similarly, in a study, the facial axis together with the lordotic angle and the pelvic inclination, the inner gonial angle and the mandibular plane with the lordotic angle and the pelvic inclination, as well as the facial depth with the pelvic inclination showed a significant correlation.

Relationship between features of skeletal class II malocclusions and head posture has been described and it is claimed by studies that retruded mandibular position and reduced mandibular length have an effect on craniocervical posture, and there is increased lordosis in these subjects. Also, the degree of cervical lordosis was shown to be associated with vertical craniofacial morphology and anterior overjet, with skeletal class II having an anteriorised and class III a posteriorised head and body posture. In these studies age was not considered as a confounding factor, but the fact is that with age lordosis increases. It was hypothesized that jaw posture may influence muscles and cause postural adaptations at spine level. Unilateral cross-bite has been investigated as a risk factor for asymmetric jaw growth and unbalanced muscle activity. The evidence is lacking whether the uncorrected cross-bite may lead to the development of deformity at spinal level.

Gonzalez and Manns postulated that the Forward Head Position (FHD) is characterized by an extension of the head together with the upper cervical spine (C1eC3), accompanied by a flexion of the lower cervical spine (C4eC7), whereby the cervical curvature is increased, a condition called hyperlordosis. However, it's commonly observed in TMD patients a hyperextension of the upper cervical and a straightening of the lower cervical spine. Posturing training has also been advised by clinicians and Nicolakis et al have designed and implemented a management protocol

based on passive mandibular movements, correction of the body posture and relaxation techniques in twenty TMD patients with previous TMJ disk displacement without reduction and according to them promising results have been achieved.

As far as signs of TMDs and occlusal features are concerned literature is little to offer as an evidence to associate certain occlusal features to TMDs and muscle disorders. Occlusal characteristics should be seen as means through which the forces are transmitted to the different structures of the stomatognathic system. Also the presence of an occlusal abnormality may be due to joint degeneration or remodeling resulting in an occlusal shift. Further subjects with TMD history respond in a different manner when compared with the subjects without TMD history. The former are reported to have an increased risk of reporting. From a neuromuscular practitioners perspective it would be important not to use such observations as definitive one. Such reactions may be an acute phase reactions and cannot be compared with TMDs, which have a long-standing history and take years to establish.

Occlusion [2]

Occlusion is an extension of general postural considerations that goes beyond the understanding of cusp to fossa relationships. It is a dynamic phenomenon that includes the afferent proprioceptive sensory input affecting the central nervous system mechanisms and resultant states of muscle tonicity. It is a historic subject of study that has been made by dentists who have attempted to “measure” the mandibular component of dental occlusion from a static perspective, mostly utilizing various forms of mechanical apparatus to support and confirm their convictions, only to leave behind further artifact, inaccuracies and confusion of a bio-physiologic system. It is a fundamental element in dentistry that almost all departments of dentistry (prosthodontics, restorative, oral maxillo-facial surgery, orthodontics, periodontics, pediatric dentistry) are concerned with. One of the key issues every generation of our profession has had to face.

In prosthodontic dentistry where the aim is artificial reconstruction of occlusion to harmonize with the entire stomatognathic system, two major schools of theory have been advocated: One is the mechanical occlusion theory initiated by Bonwill (1858), where emphasis is placed upon mandibular movement. The mechanical occlusion theory has been dominant in prosthodontics over the past 100 years and has led to the development of numerous adjustable articulators, devices and related clinical techniques. The mechanical occlusion theory is based on a belief that the temporomandibular joints hinge on an axis of rotation in the glenoid fossa of the skull. All occlusion is guided and brought together to a finely tuned order, determined by the axis of jaw joint rotation. The emphasis is on occlusion and TM joint position that has been fundamentally called "centric relation".

The second occlusion theory is based on neuromuscular physiology, the functional occlusion theory. This theory indicates that the functional occlusion system is made up of four major components: teeth, muscles, nerves and temporomandibular joints. Its basis of understanding is that the temporomandibular joints are in a physiologic rest position based on the guidance of muscles, neurally controlled and stabilized by the occlusion, all integrated with its peripheral proprioceptors and relax mechanism of the central nervous system. The emphasis is on establishing a physiologic relationship of the mandible to the cranium resulting in a neuromuscular rest position to support a physiologic established occlusion for stability of the jaw joints, the masticatory muscles of the head and neck, and the teeth with the surrounding periodontium.

Both these philosophies have been strongly debated among clinicians who have been seeking the answers to the mysteries of occlusion with all its challenges that include the treatment and management of the mandible, the muscles of mastication, the supporting hard and soft tissue structures of the temporomandibular joints that make up the structural component, the nutritional, as

well as the emotional factors that effect the patient. Jaw joint position has been a major emphasis among the various schools of thought, with strong opinionated feelings to support each ones view, clinical experience and teachings they have received.

Although this hinge axis position is the foundation to traditional occlusal diagnosis and treatment and advocates boast of its accuracy, precision, and repeatability, experts continue to disagree where an optimal condylar centric and mandibular position is located. Pameijer has noted in his text, "It can be assumed that centric relation is not a continuously stable position of the mandible for any given length of time, but a position which is not in the least stable once the regulating influence of the neuromuscular mechanism and anatomical changes are taken into account. He further states, "The discrepancy between centric relation and maximum intercuspation is a reality which every clinician performing occlusal therapy must accept. The question – 'at which mandibular relation maximum intercuspation should occur in order to obtain a harmonious entity with the neuromuscular system then needs to be answered." Though this term "centric relation" is commonly used among the traditionalist still to this day, literature indicates that it continues to evolve in meaning.

Questions facing clinicians restoring full arches [2]

The confusion surrounding occlusion theories in dentistry today only raise a fundamental concern about what position should the jaw joints be in when restoring the chewing structures of the mouth. Many clinicians who have been faced with restoring full dental arches were also faced with questions such as:

1. What is the proper **vertical dimension** of occlusion and how can one determine it?
2. What is the **optimal condylar position** within the glenoid fossa in which dental occlusion is connected to the mandible on one end and the joint at the other end?

3. What is the **optimal anterior/ posterior position** of the mandible when restoring the mouth and how does one determine it?
4. Is there temporomandibular joint **pathology present** even though the patient may not complain of pain?
5. How will a pathologic joint affect the clinician's treatment outcomes and occlusion?
6. What impact will **muscle tenderness** of the head, neck, face and shoulder regions have on treatment outcomes, short-term and long-run?

These concerns are surpassed only by the multi-factorial signs and symptoms associated with craniomandibular dysfunctions (TMD) that clinicians recognize or ignorant of the symptoms the patient presents with. Although these concerns continue to plague our dental profession it becomes apparent that objective and measurable parameters must be implemented to begin to unravel the knot of confusion as to how best to begin a mode of treatment and resolve the opinionated confusion. The following four questions most pertinent in regards to the theory, the practice, or application (method) of occlusion in the daily practice of dentistry may be asked:

1. What objective data can be provided to support the traditional mechanical theory of mandibular position to best ensure muscle harmony?
2. What accepted measurable physiologic standards are used by the clinician to establish the physiologic maxillo-mandibular position?
3. How does the clinician document and validate a patient's physiologic response to cranio-mandibular/occlusal therapy?
4. Since every dentist has experienced patients developing clinical symptoms after minimal dental procedures, how can the dentist identify sub-clinical pathology that may be exacerbated into full blown symptoms, ie, headaches, ear



symptoms, joint noise, joint pain, atypical facial pain, neck aches, etc. after simple dental procedures?

How Neuromuscular Dentistry complements Gnathological principles [2]

Although it has been expounded that the neuromuscular dentistry principles are a radical departure from the traditional gnathological principles, it is not. Neuromuscular dentistry has simply added to the knowledge base of gnathology through the use of technologies that have evolved during the last quarter of the twentieth century. B. B. McCollum once said, "If the dentist is to understand oral physiology, he must understand the actions of the joints and the muscles that operate the mandible. How the muscles and joints make the mandibular motions is the primary and, no doubt, the dominant part of oral physiology..... And it is the function of dentistry to ascertain by diagnostic means all or any involvements of the mandibular joints and muscles due to conflict of the teeth with these muscles and joints." It is through these diagnostic technologies that brings new light in understanding the oral physiology of muscle function.

Neuromuscular dentistry is a comprehensive medical paradigm that:

1. Acknowledges the multifaceted musculoskeletal occlusal signs and symptoms as they relate to the complete postural issues of the head, neck, mandibular position, muscle activity status and the temporomandibular joint position, all which in turn impact the occlusal position and relationship of the teeth. It is by these related systems that craniomandibular disorders are intimately tied.
2. Utilizes the diagnosis and treatment of occlusal problems that takes into consideration the status and influences of the masticatory muscles.
3. Utilizes objective and scientific diagnostic instrumentation to *measure objectively and accurately* the status of mandibular physiologic rest in relation to

the craniomaxillary complex as a starting position for a more efficient function of the masticatory muscle system in relationship to habitual centric occlusion.

4. Recognizes a physiologic mandibular opening and closing neuromuscular trajectory along an isotonic path for stability at a terminal contact position.
5. Recognizes and measures mandibular torque and imbalances that contribute to the afferent and efferent noxious proprioceptive stimuli during mandibular closure with freedom of entry and exit from terminal tooth contact (micro-occlusion).

Based on the foregoing premises the clinician is able to develop a diagnosis and treatment plan with objective data to make informed clinical decisions as it relates to the diagnosis, but also the *treatment of CMD/TMD*.

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The philosophical premises foundational to the neuromuscular approach are based upon universally accepted medical models of health versus pathogenesis. It is a therapeutic medical paradigm that results in decompression of the jaw joints rather than compression reducing load and strain to the joint complex. It is universally agreed among medical colleagues that relaxation and decompression are elemental to all therapeutic paradigms for treatment of the musculoskeletal system.

Also recently, NMD is suggested to expand and include, besides occlusion and mastication, the complex phenomenon of swallowing thereby involving the skeletal muscles of the tongue and smooth muscles of the pharynx and esophagus, a new 'diamond' concept [9] was proposed for NMD from the traditional triad concept [4].

Science and technology behind Neuromuscular Dentistry [2,3]

Science and technology in the dental field has advanced to a higher level of understanding the masticatory system and accompanying structures through the work of Bernard Jankelson and continues to this day by scholars, academicians and clinicians. It is based on scientific instrumentation from

which objective quantifiable data can be recorded to assess mandibular movements in function and an optimal physiologic rest position. Numerous scientific studies have been published in scientific and refereed journals nationally and internationally to bring to light the dynamics of mandibular function, muscle activity during resting modes and active modes. Recordings and acquired data can effectively document optimal physiologic mandibular position for each individual patient. Clear reliable evidence can now be gathered and studied to understand the true patho-physiology of mandibular movement, muscle activity, mandibular function and its relation to occlusion/teeth and the temporomandibular joints for each individual patient needing treatment far beyond the mechanical devices that only show static relationships of mandibular movement.

The capacity to analyze gross and now fine detailed movements of the mandible takes gnathology and neuromuscular dentistry one-step further into micro-occlusion. Traditional gnathology and today's present occlusion leaders have said, "The most common shortcoming in analyzing or treating occlusal relationships is failure to consider all the parts of the masticatory system. We are prone to many mistakes if our understanding of occlusion is limited to occlusal contacts alone, but the evolving of computerized biotechnology has helped unlock the mysteries of occlusion, mandibular function, joint positioning and craniomandibular disorders far beyond the mechanical occlusion theories with their articulating devices.

The various tools of Occlusal Diagnosis and Treatment are

1. SURFACE ELECTROMYOGRAPHY (SEMG) accurately measures muscles at rest and in function.
2. ULTRA LOW FREQUENCY TENS (Myo-monitor/ ULF TENS) - Relaxes the muscles of mastication allowing an accurate

recording of the physiologic relationship of the mandible to the cranium. It also propels the mandible along a relaxed trajectory.

3. COMPUTERIZED MANDIBULAR SCANNING (Jaw Tracking) - CMS accurately measures the motion, velocity and mandibular movements in six dimensions.
4. ELECTROSONOGRAPHY (ESG) - Records, measures and locates joints sound in function.
5. RADIOGRAPHY - Panoramic, submental vertex, corrected cut tomograms or transcranial, lateral cephalogram, AP cephalogram, and lateral cervical spine films provide a tremendous amount of static subclinical information about the fossa/condylar relationship as they relate to the craniomandibular cervical structures of the postural system.

Implementing these tools, either individually or in combination allows the clinician to visualize and record relationships between bio-physiological and anatomical structures. These tools can also be effectively used when taking a SEMG guided bite registration. SEMG's are monitored "simultaneously" with CMS. Computerized diagnostic instrumentation supports the physiology of mandibular movement and confirms an optimal temporomandibular joint position. Assuming the habitual/acquired bites, on most patients are a correct starting point for any dental treatment one will soon find that a pathologic occlusal position may not be the best starting point for a diagnosis and optimal treatment. Hypertension of the masticatory muscles may affect the occlusion (torques and strains on tooth structure), surrounding periodontium, and cervical head and neck region, leading to a misdiagnosis and unnecessary clinical treatment. Tomography of the joints, when indicated will clearly assist in confirming joint pathologies. The clinician should also realize that these static radiographic aids should be combined with a more dynamic evaluation of CMS, EMG and sonography to ascertain a more complete picture and assessment of the problem presented. Lacking an awareness of man



dibular dynamics as they relate to the clinical findings is common, since most dentists have never acquired the training, skill and knowledge to correlate objective computerized bio-physiologic data with clinical findings.

Similarities between Gnathological and Neuromuscular approaches

There is more similarity between the gnathological and neuromuscular philosophies in their purist sense to treatment than dissimilarities such as [2]:

1. Desirability of delivering forces in the long axis of the tooth
2. Dentistry is a branch of the medical sciences and that these concepts are for the understanding and creation of total dental health
3. There exists a finely tuned order in which teeth contact

Future trends in Research and Innovations

Although great strides and progress have been made from the classical gnathology concepts to the more recent neuromuscular concepts, future investigations and research should include [2]:

1. Posterior jaw tracking for a true 6-dimensional mandibular evaluation.
2. Grid surface SEMG and first tooth contact correlations.
3. SEMG signal differentiation muscles such as medial and lateral pterygoid.
4. Clinical applicability of skin mechanoreceptive, thermoreceptive, and nociceptive measurements. (Neurophysiology, EEG).
5. Muscle nerve sympathetic activity in relationship to vascular baroreflex and skin nerve sympathetic activity in thermoregulatory functions.
6. Potential of SEMG electrode grids in evaluating the level of muscle unit synchronization.

Conclusion

Modern medical and dental science has progressed beyond the traditional concepts. Gneuromuscular (GNM) dentistry focuses on how gnathic (G) and neuromuscular (NM) principles are applied clinically in the occlusal management disciplines at the highest levels.

The goal of GNM is to physiologically address how teeth, muscles and joints optimally move rest in health and how occlusal signs could be indicators of possible underlying dysfunctions. Clinically, low frequency TENS can assist the dentist in capturing a more physiologic bite registration. CMS instrumentation is used to scientifically and objectively align the mandible with TENS with precision. Past occlusal and joint concepts have proven insufficient to predictably address muscular issues in cases that require more than routine habitual occlusal care. The GNM approach uses scientifically based technology that records and verifies the clinician's observations beyond mere subjective assessments [8]. The GNM approach is a comprehensive clinical approach that addresses the cause and source of musculoskeletal occlusal signs and symptoms and provides protocols and techniques for the dentists to implement effective restorative, orthodontic and TMD treatment for their patients [10].

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