Integrating Neuromuscular Dentistry Principles into Orthodontics

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Editorial

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Orthodontics is considered one of the most unexplored specialties of dentistry. We have seen in the last few years that many specialties, such as endodontics, implantology and prosthetics, have made considerable progress with the introduction of new techniques and diagnostic aids that are possible with today's great advancement in technology and digital radiology. But what about orthodontics? Besides the use of mini implants for anchorage, most of the publications in recent years have focused on disassembling the many certainties that orthodontists were linked to. We have seen very few advancements in orthodontic diagnosis and treatment that really gave us a change. NiTi wires were introduced more than 20 years ago and self-ligating brackets over 15 years ago. Doubts have arisen over cephalometrics, biomechanics and growth, and most of all, we have started having suspicions that our treatments could be a cause of temporomandibular (TMD) disorders. Several publications have rushed to prove that TMD could not be caused by orthodontic treatment, but at the same time stated that orthodontic treatment could reduce TMD symptoms [1-5]. This was certainly beneficial for orthodontists, but surely a lot less so for our patients.

Suddenly, the focus orthodontists had on occlusion, and specifically teeth, started moving towards other areas of the human body. Unconsciously many orthodontists today take the TMJ into consideration in their treatment planning and avoid extractions when possible. This attitude and change of direction is desirable, since it has been driven by the deepened knowledge and experience of the practitioner over years of practice, but most of all, it is the result of scientific evidence that occlusion is directly linked to pathologies in body areas anatomically far from the mouth [6]. TMD, or temporomandibular disorder, is today's terminology for defining all those symptoms that arise from causes linked to the TMJ that spread to areas directly or indirectly connected to this joint. Can we continue to hide the fact that moving teeth change the position of the condyle in the TMJ? So why do we use a bite to alleviate symptoms in these patients? Because we recognize occlusion as one of the main keys to TMJ function and malocclusion to TMJ dysfunction. By giving a bite to our TMD patients, we attempt to decrease strain on the TMJ and surrounding muscles. Pharmacological and psychological aid is also advisable in severe cases, but we rely mostly on our occlusal distraction or repositioning. The quest to find a new centric occlusion (CO) has pushed many authors to promote several methods of "bite registration", sometimes with success, but most important of all, without constant results. There is no pathway to a perfect profession, but avoiding some misconceptions that are fixed in the practitioner's knowledge will bring a beneficial wave of open-mindedness to our profession.

TMD is not a pathology limited to adults. Recent studies describe how frequent TMJ disorders can be present in young adults and how occlusal problems can be linked to a common headache in children [7-14]. The role of the orthodontist as a practitioner who can deliver a lifelong pain-free functioning of the TMJ increases their responsibility in seeking the most up-to-date knowledge and the most risk-free procedures. The debate between "functional" and "nonfunctional" orthodontists has gone on for years, and is not going to end soon. Functional orthodontists have in some way worked to promote a "face-forward" type of treatment, while other practitioners have worked in the opposite direction. The idea that the mandible can be set to a new posture and be, for that reason, stimulated to grow is indeed fascinating. Treatment of Class II malocclusions with functional appliances seems, in general, a more logical orthodontic approach because it focuses on re-establishing a new functional equilibrium rather than the sole occlusal relationship. But besides this never-ending debate, there are not only Class II malocclusions to treat. Class III malocclusions will still be treated in the same way by many orthodontists: Achieving a correct overjet and overbite still seems the main objective of orthodontic treatment. What about the TMJ? A deeper look at TMD-related occlusions shows that the most frequent pathological position of the condyle is its distal setting in the glenoid fossa [15]. So, what is our role in these cases? Should we push to compensate the occlusion, putting the TMJ at risk, or should we seek new diagnostic and therapeutic procedures? Should we continue to consider cephalometrics an important diagnostic tool or should we start focusing on physiology?

Neuromuscular dentistry (ND) focuses on increasing the array of diagnostics and taking into consideration a wider spectrum of occlusion-related symptoms. The broader and more holistic approach ensures a better understanding of the physiology of the individual. Computerized mandibular scanning (CMS) and surface electromyography (SE) are measuring systems that enable the practitioner to view patients' objective functional data. The use of transcutaneous electrical nerve stimulation (TENS) to relax muscles and register a new craniomandibular relationship is a basic step in this procedure. Various studies have confirmed the efficacy of these instruments, which, used together, are the fundamental instruments in the hands of the neuromuscular dentist [6, 16-26]. The main goal of this procedure is to identify an "unconditioned" rest position, in contrast with the habitual, everyday rest position conditioned by occlusion. This distraction procedure is carried out by applying TENS to the patient while occlusal contacts are avoided by means of wax or other interocclusal material. The central nervous system (CNS) stops receiving afferent inputs from the periodontal ligaments (and from other tissue-related receptors), allowing the mandible to settle in a new rest position. TENS (an ultra-low-frequency TENS) also induces a mandibular movement unconditioned by occlusion and the CNS, which is recorded and calculated as a natural trajectory towards closure (myotrajectory). It is on this functional trajectory towards closure that the new CO is identified and recorded (MyoCentric).

The detection of this new ideal centric occlusion should be the starting point for all diagnostic procedures in dentistry and orthodontics. In particular, the mandibular rest position will be accompanied by relaxed postural muscles. SE will monitor muscle function in many of its aspects and will ensure harmony of muscle output during occlusion and rest. Neuromuscular dentistry is the study of the rest position of the mandible; it takes into consideration TMJ function, muscles, nerves and fascia and not only teeth. For too long we have given our main attention to teeth and occlusal relationship while forgetting TMJ and muscle function.

Neuromuscular orthodontics (NO) represents the application of these principles to orthodontic diagnosis and treatment. Creating a functional occlusion in which muscle function is not the result of any accommodation is the main objective in NO – a stable occlusion in which muscles are relaxed and function in harmony during swallowing. It is only during deglutition that teeth come to CO, so assessing the quality of the swallow pattern reflects the everyday physiology nearest to reality. The correction of freeway space via natural or forced orthodontic extrusion establishes well-defined changes in craniocervical posture. Understanding the importance of physiological freeway space is the first step in conceiving this relatively new occlusal paradigm. We must start planning our diagnostics and bite registrations in a 3D fashion. The study of the dynamics of mandibular movements mimics the reality of everyday life. NO represents the missing leap orthodontics has lost while other dental specialties have thrived.

So, directing our attention to a wider perspective, NO not only includes the correction of crooked teeth as the main and only objective of treatment, but aims to establish a balanced muscle function with minimal adaptation to rest position. Fascia, nerves and tendons thus act and counteract with minimal compression/tension adaptation. This is brilliantly explained in biotensegrity [26], a more modern and logical way of interpreting anatomical structures. The TMJ acts like a tensegrity structure that balances and distributes tension and compressional forces throughout the anatomical TMJ as a whole and not with pure mechanical directional forces, as previously believed in the mechanistic models of the early 1900s. This ensures that reducing tensions and compressional forces, such as hypertonic muscle or fascial entrapment, must lead to a better TMJ function. The biotensegrity model applied to the TMJ explains why compressional forces, such as those employed during hard chewing, transform the TMJ momentarily into a stronger and more responsive organ. For this to happen, the starting point must be a biotensegrity structure that conserves all its anatomical structures with the lowest point of strain. For the TMJ, this will include *all* the anatomical components and not only the condyle and disk. Muscles, fascia nerves and blood vessels and intra-articular fluid must also participate in this continuum. This energy-efficient system is characterized by a “nonlinear” anatomical response of the biological structures to stress (J.E. Gordon).

Neuromuscular orthodontics represents a breakthrough in uncovering the hidden physiological characteristics of our patients. This leads to better treatment options and, most of all, to a better diagnostic assessment and treatment planning. State-of-the-art technology is available and easy to use. A new exciting moment is here and we should take advantage of it.

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