

Re-establishing Physiologic Vertical Dimension for an Overclosed Patient

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INTRODUCTION

The term 'neuromuscular occlusion' has been associated with certain limited methodologies that are used to obtain a muscle-compatible occlusal relationship. In reality, there are several different approaches that can be used to determine a neuromuscular maxillo-mandibular relationship, even in a fully edentulous case. Within each method, however the common basis for all muscle-oriented approaches involves determining the resting length of the masticatory muscles.

Historically, opening the bite has been considered hazardous and/or foolhardy by many dentists and with good reason. Arbitrary opening of the bite, especially when accomplished strictly on an articulator, can result in a difficult, discomfort and unappreciative patient. Some dentists have recommended against opening a bite, perhaps after a troublesome experience with the patient.

In spite of risks, there are many advantages associated with opening an over-closed or deep bite. The identification can be traced back at least 70 years to an ENT physician, Dr JB Costen.¹⁻³ Costen discovered, perhaps by accident after referring many of his symptomatic edentulous patients to a local dentist for new dentures; many returned with their head and ear pain symptoms greatly relieved. His publications were positively received at that time; in fact, what we refer today as temporomandibular disorders (TMDs) were originally referred to as "Costen's Syndrome." While we know today that many TMD patients are not over-closed; they do often exhibit some of the signs and symptoms commonly associated with TMD. Although over-closure in itself is not pathognomonic of TMD, it should be considered as a risk factor.

The use of patient's own muscles to determine the vertical dimension of occlusion was already being explored in the 1940's by orthodontist like John R. Thompson.⁴ Sears⁵ introduced the concept of the "Pivot Appliance" in the 1950's, which was designed to open the bite enough to allow the patient's muscles to reposition the mandible. Following them, others⁶⁻²⁸ subsequently evolved with the current array of neuromuscular registration methods presently in use. At

the same time several studies²⁹⁻³² have demonstrated that a muscle-determined position, although similar, is not identical to centric relation.

SIGNS & SYMPTOMS OF BITE OVER-CLOSURE

When asked, over-closed patients often report symptoms such as frequent headaches, dull pain of the elevator muscles and pain or stiffness in their neck muscles. Ear stuffiness, tinnitus and/or vertigo are also commonly reported. A more subtle symptom, less often reported, is frequent gastrointestinal distress in various forms that has no clear, identifiable cause. This may also be accompanied by a report of difficulty in chewing and/or swallowing. An overclosed patient will usually report several, but not all, of the following symptoms: 1. Frequent headache with no identifiable cause, 2. Ear stuffiness with no indication of ear pathology, 3. Difficulty in chewing tough foods, 4. Difficulty or discomfort in swallowing, 5. Frequent gastrointestinal distress, 6. Vertigo, 7. Tinnitus, 8. Persistent dull pain in masticatory elevator muscles, 9. Neck pain or stiffness, 10. Possible increased wear of incisor teeth.

Under examination, a number of signs indicating over-closure may appear. These include: 1. Freeway space greater than 3 mm, 2. EMG or visual identification of a tongue-thrust swallow, 3. Appearance of less than fully erupted molars, 4. Deep curve of Spee, 5. One or more posterior edentulous spaces, 6. Lingually tipped mandibular molars, 7. EMG identification of elevator muscle hyperactivity at rest of more than 2.0 microvolts average (or 2.2 microvolts RMS), 8. Worn and shortened teeth, 9. Horizontal skin creasing and saliva weeping at the corners of the mouth, 10. Measurement of less than 16 mm from the cemento-enamel junction of the maxillary central incisor to the CEJ of its opposing mandibular tooth in centric occlusion (Shimbashi measurement), 11). Long-term chronic internal derangement of the TMJ.

However, patients rarely seek dental treatment for any of these objective signs. Instead, they are more likely to seek rehabilitative treatment for headache, jaw-ache, ear-ache, difficulty in chewing/swallowing or for purely esthetic reason. In other cases they are unaware of their condition, apparently

due to their excellent adaptability. In the over-closed patient the reason for treatment, either cosmetic or functional, is often dependent more on individual adaptability than on the dental conditions present. While some signs simply indicate the "progress of the destruction" that a pathological maxillo-mandibular relationship fosters, other signs may indicate a successful adaptation:

1. Freeway space >3 mm [if pain level is low, it is an adaptation, otherwise it is not]
2. Tongue thrust swallow [if full arch tongue thrust, usually a successful compensation]
3. The appearance of less than fully erupted molars [tongue inhibition of natural eruption]
4. Deep curve of Spee [often associated with one or more missing molars or a deep anterior overbite with retroclined upper incisors]
5. One or more posterior edentulous spaces [leads to deep curve of Spee]
6. Lingually tipped posterior teeth [tongue thrust during swallow, restricted maxillary arch]
7. Hyperactivity of elevator muscles at rest [an adaptation, successful if no elevator muscle pain]
8. Worn/short teeth, abfractions [not a successful adaptation]
9. Skin creasing at corners of mouth [may appear as aesthetic problem only, not an adaptation]
10. Saliva weeping at corners of mouth [an esthetic and functional problem, not an adaptation]
11. CEJ to CEJ in CO < 16 mm [less than the normal adaptive range]
12. Internal derangement of the TMJ [if no degeneration, may be a successful adaptation]

Maxillo-mandibular Bite Relationships

Centric Occlusion (CO):

The maxillo-mandibular position of maximum intercuspation is most often the dental treatment position, primarily by default. This is of necessity whenever single tooth preparations or small restorations are involved, since they must fit within the patient's existing occlusal scheme. It is only at times of major reconstructive, orthodontic and/or surgical treatments that the option of opening a bite or establishing a new maxillo-mandibular relation may present itself. However, many clinicians still prefer to "play it safe" and retain the existing habitual (CO) maxillo-mandibular relationship, even during major rehabilitative procedures. By definition, the use of centric occlusion as a treatment position excludes re-establishing a proper vertical dimension in an over-closed patient. However, if the patient's condition is actively deteriorating this may not be a safe option at all, as the continued physiologic breakdown may lead to failed dentistry and/or a flair up of craniofacial pain.

Centric Relation (CR):

The concept of centric relation has a very long history and was originally devised, at least in part, to accommodate the use of articulators during prosthodontic treatment. Although we now know that the jaw does not function like a hinge, originally it was convenient to make that assumption when using articulators to make prostheses. Today, one clear difference between centric relation procedures and strictly muscle-oriented methodologies is the priority given by CR methods to evaluating the function of the TMJ. Typically, centric relation operators give first priority to establishing stable joint function, while muscle-oriented (neuromuscular) approaches tend to focus almost exclusively on muscle comfort.

Muscle-related Centric (MC):

In general, muscle-oriented approaches consider joint position and/or stability secondary to muscle function. In the extreme, it is simply assumed that creating "happy muscles" will automatically provide good or at least adequate joint function. In a more practical view, both joint function and muscle function are seriously evaluated and, when indicated, a compromise is sought to provide both joint and muscle compatibility. It represents an approach that bridges the gap between strict CR and rigid MC approaches. Consequently, a variety of methods have evolved to establish a muscle-related centric position, while maintaining favorable joint function.

Neuromuscular Occlusion (NMO):

The first step in all approaches to NMO requires inducing relaxation in the masticatory musculature, however, there is no rational excuse for not evaluating TMJ function prior to begin the process. This can be accomplished quickly and easily with Joint Vibration Analysis (JVA, Figure 1), or with more expensive and invasive imaging such as MRI. Muscle relaxation can be aided by Ultra-Low Frequency TENS (ULF-TENS, Figure 2), an aqualizer, soft music or any other technique that reduces the resting hyperactivity of the masticatory muscles. Surface electromyography (Figure 3) is useful for making a quantitative determination whether relaxation has occurred or resting muscle hyperactivity still exists. Needles and/or fine wire electrodes not only make relaxation less likely, they record a more localized signal that is less representative of overall muscle activity. However, needle EMG electrodes are required when one is seeking to differentiate a myopathy from a neuropathy. Using relaxed rest position of the mandible with respect to maxilla as a reference, a clinician can select a vertical dimension that allows adequate freeway space, yet avoids over-closing the bite.



Figure 1: BioJVA* testing for normal TMJ



Figure 2: Bio-TENS,* a ULF-TENS unit used for muscle relaxation



Figure 3: BioEMG II* for monitoring rest position and testing muscle function against the new bite

Muscle-oriented bite registration techniques

Wax Swallow Bite Registration:

A physiologic, muscle-oriented, vertical dimension can be obtained by means of swallowing reflex technique originally proposed by Dr. Willie May. Currently, the wax swallow bite technique, developed by James Carlson is a simple, direct close approximation of a muscle-related bite registration. Small pillars of soft wax are placed on the first molars, then the patient is instructed to swallow several times. Subsequently, fast-curing impression material is injected around the arch to firmly establish the maxillo-mandibular relationship. Since humans swallow thousands of times per day, it has been proposed that the swallow position should be compatible with the musculature. This technique is recommended only after verification of good TMJ function with Joint Vibration Analysis or MRI.

ULF-TENS Bite Registration:

Ultra-low Frequency TENS, originally conceived by Bernard Jankelson, is often used to relax the masticatory muscles. It can also be used to determine a bite registration position, sometimes referred to as myo-centric. After a patient has been "pulsed" for relaxation, usually for about 40 minutes, bite registration material (a quick-cure acrylic) is placed over the mandibular occlusal surface and the ULF-TENS is reapplied to "close" the mandible about 1-2 mm above the rest position. During this procedure the vertical dimension is usually monitored with a mechanic's inside calipers between marks on the chin and nose. It is a technique sensitive procedure

because different operators tend to produce different results. However, once the skill is developed, an operator may produce good consistency. These classic TENS bites ignored the TMJ function in the past, but this should no longer be the case. A final outcome with healthy TMJ and muscles is the goal today.

Phonetic Bite Registration:

As with the previously described muscle-oriented methods, this one begins with muscle relaxation. Then the patient is instructed to speak specific sounds while the anterior teeth are observed by the clinician. Based on the positions assumed by the teeth with specific phonetics, the clinician recognizes the vertical and antero-posterior requirements and records the position, typically also with impression material. Admittedly, this technique requires subjective clinical judgment and the development of a skill without any objective support.

EMG Bite Registration:

To enhance the precision with which one can determine the optimum muscle-related position, some practitioners recommend monitoring the activity of the masseter, temporalis and anterior digastric muscles electromyographically (Figure 4). Since the electrical muscle output levels involved are just a few microvolts, this measurement requires a high common mode noise rejection amplifier. After relaxation has been verified electromyographically, the patient is instructed to open gradually until the digastrics show a slight increase in activity (e.g. 0.5 microvolts average). This establishes the limit to which opening the bite is permissible and is typically



Figure 4: JT-3D* Jaw Tracker used together with EMG to monitor a bite registration

used as a position for constructing removable orthodontic appliances. Similar tests are done for closing or repositioning the bite antero-posteriorly while monitoring the elevator muscles. The concept is to find superior, inferior, anterior and posterior limits of muscle resting. Then the new bite position is selected within these limits. The exact relation chosen may be dependent on many factors, such as clinical findings and the clinician's best judgment. With this technique it is also possible to evaluate functional activity of the musculature with the bite registration in place to further evaluate the appropriateness of the new maxillo-mandibular relation.

Instrument-monitored Bite Registration:

To maximize the precision with which one can determine the bite registration position, clinicians can actively monitor the position of the mandible using a magnetic jaw tracker while simultaneously recording EMG activity. After the muscles are relaxed, a recording is made of the movement from rest to centric occlusion, light tapping in CO and protrusive guidance. Next, the registration position is selected and targeted on the computer screen. The treatment position chosen can reflect all the information available regarding the patient's current condition. Finally, the registration material is placed in the mouth and the patient is instructed to close into it while the position of the mandible and the muscle activities are monitored on the computer screen. This allows the clinician to immediately see the three dimensional relationship between the old centric occlusal position and the

new bite position. The saved recording can be recalled later and utilized to evaluate an appliance, provisional restorations or the prosthesis try-in.

Predicting a patient's response to correcting overclosure

The question is often asked, "How quickly will a patient adapt to a new bite registration?" Even though the object is to "correct" a mal-relationship of the mandible to maxilla, the patient's current relationship still has familiarity. The new relationship, no matter how "perfectly" established, will seem strange to the patient at first. There are many factors that influence patient's adaptation to a new maxillo-mandibular relation. It is possible to estimate a patient's response by considering the following factors:

1. Age of the patient [younger = more adaptive, older = less adaptive]
2. Amount of the change [a big change is more difficult to adapt to than a small change]
3. Duration of the overclosed condition [a long-standing condition is more difficult than the short duration]
4. Quality of bilateral TMJ function [good joint function makes adaptation easier]
5. An overclosed bite, due to developmental abnormalities (if caught early) can be corrected easily and with rapid adaptation by the patient [children are much more adaptive]
6. Overclosure resulting from parafunction typically coincides with a strong, healthy musculature. Strong, healthy muscles make adaptation easier, but require a treatment plan to protect the restored occlusion from destructive parafunctional forces.
7. An overclosed bite due to caries, loss of teeth, etc. without the evidence of parafunction, typically coincides with a weak musculature, making adaptation difficult.

CONCLUSION

Overclosure is a common condition among patients seeking restorative and/or orthodontic rehabilitation. By evaluating the patient for common signs and symptoms associated with overclosure, one can determine the need for reestablishing a physiologic vertical dimension. Opening of the bite can be accomplished in a number of ways by following specific guidelines. The use of objective diagnostic aids are extremely helpful by allowing the clinician to optimize TMJ and craniofacial muscle function at the new VDO. The correction of the vertical dimension during a rehabilitative procedure should result in enhanced comfort and improved function in the finished case.

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