The Journal of
Functional and
Fixed Orthodontics

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This Edition features articles by
Dr Derek Mahony,
Dr Bill Clark
and Graham Manley
Merry Christmas and a Happy and Prosperous New Year

Ortholab will be closing for Christmas Holidays from 3.30pm on Friday 19th December until 9am on Monday 12th January. Please note that the last day for accepting cases to be finished before the Christmas break will be Friday 12th December.
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Hello and welcome to our journal!

Christmas is almost upon us!! As I’ve got older, it seems they come around so much faster. As December comes, ever increasing patients want to get their braces off so as to show off their new smile for Christmas. In the lab, the number of new cases winds down but the number of retainers more than make up for it. It’s a hectic time, Hawley’s, Essix, Clearbow and many other types are made with increasing frequency as the last day draws nearer.

Stress levels increase in the lab as I’m sure they do in the clinic as impressions flood in and retainers flood out. And at the back of everyone mind is finish time for the last day this year. At last, a time for extended relaxation, Christmas celebration with family and friends and, if you’re lucky, a holiday. Time to chill out, take stock of the year just gone and think about your grand plans for the year ahead.

What will you do different next year? Will you start more cases, increase your marketing to attract new patients, buy that new piece of equipment you’ve been thinking about, what will it be?

Dentistry is the fastest changing medical science and orthodontics is the fastest changing dental science. Keeping up to date is becoming more and more difficult. Courses are run, some costing way too much, and some for free. Why not, in this upcoming year, make a promise to yourself to attend a few more courses. Education is a life long process, it’s also a very powerful asset, one you can use in your practice to make life easier for you, for better treatment for your patient and to increase your bottom line.

Think about making education one of your priorities for 2015. Have a fantastic Christmas, New Year and Holiday Season.

Graham Manley
The Sagittal Expander is specifically designed for antero-posterior arch development in upper or lower dental arches, and is often indicated for simultaneous use in both arches.

Labial movement of the anterior teeth may be combined with transverse development of the buccal segments where indicated by activating the mesial extension wires to move premolars or deciduous molars, or to expand intercanine width. As the modules expand this also achieves expansion of the inter-molar width. The sagittal appliance is pre-activated to achieve the amount of expansion required.

The Sagittal Expander is provided in seven sizes. The mesio-distal length of the appliances varies by 2 mm increments throughout the range. The range of action of the sagittal appliance is 6 mm in the larger sizes, which are used only in the upper arch. The smaller sizes with 4 mm range of action, can be used in the upper or lower arch. Careful selection is advised to provide the correct amount of tooth movement required for each individual case.
TRANSFORCE SAGITTAL ARCH DEVELOPMENT

This boy has a Class I buccal segment relationship with retroclined upper central incisors and crowding of the lower labial segment. Upper and lower TransForce Sagittal appliances were used to correct arch form and align the anterior teeth. The lower appliance was fitted first to advance the lower incisors and reduce the overbite before fitting the upper sagittal appliance. This avoids having the lower incisors damaging the upper appliance in deep overbite cases.

This shows the improvement in arch form after 9 months treatment.
Treated With Invisible TransForce Appliances

This correction was achieved with invisible lingual appliances without fixed appliances. Rapid tooth movements occur without any frictional resistance. This concept can be used from mixed dentition to adult dentition. In adult therapy invisible retainers may be used for detailed finishing and fixed lingual retainers can be fitted for long term retention.

The improvement is maintained one year after completion of treatment.
The process of selecting the correct size of the Transverse Expander uses a similar clear template showing a scale model of the appliance in both compressed and fully extended forms. The template is laid over a study model to select the size to fit the individual patient. The compressed outline of the appliance should fit inside the lingual outline of the teeth. The extended outline shows the amount of pre-activation in the appliance.

Alternatively the arch width before treatment may be measured using the millimetre scale on the template, measuring the inter-molar width from the gingival margin of the molar and the inter-canine width from the gingival margin of the canines. This distance may be compared with the compressed width and extended width of the transverse appliance on the template to determine the correct size and the range of activation.
Transverse & Sagittal Arch Development

Occlusion Before Treatment

Before Treatment  |  After Transverse Expansion  |  After Arch Development

Before Treatment  |  After Transforce Sagittal  |  After Arch Development

This patient was unwilling to have fixed appliances, but was happy to wear lingual appliances. Upper Transverse and lower Sagittal appliances were used and after 9 months a lower fixed appliance was fitted. This severe malocclusion showed a marked improvement with simple treatment and was completed in 7 visits followed by retainer.
This young adult with severe maxillary contraction was treated with Transverse Appliances for lingual arch development. She enjoyed having invisible appliances for 11 months while her smile noticeably improved before progressing to a short period with aesthetic fixed appliances to complete treatment.
The lingual approach presents minimum discomfort and inconvenience for adults. Invisible lingual appliances simplify treatment using biocompatible forces for gentle arch development. Typically, the time in fixed appliances is reduced by 50%. Treatment was completed in 19 months.
A Class 111 malocclusion with severe upper labial crowding treated in mixed dentition with upper and lower Transforce Transverse Expansion Appliances. Active treatment was completed in 8 months and the Transforce appliances remained in place for 3 months to retain.
This was followed by a short period of treatment with fixed appliances after eruption of permanent teeth. Interceptive treatment in mixed dentition to resolve anterior crowding simplified the finishing stage and significantly reduced the time required in fixed appliances.
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(Space Analysis)
Re-establishing a Physiologic Vertical Dimension for an Overclosed Patient

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Introduction

The term *neuromuscular occlusion* has become 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 with a fully edentulous case. Within each method, however, the common basis for all muscle-oriented approaches involves first 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, uncomfortable and unappreciative patient. Some dentists have recommended against ever opening a bite, perhaps after an especially troublesome experience with a patient.

In spite of the risks, there are some advantages associated with opening an over-closed bite. The identification can be traced back at least 70 years to an ENT physician, Dr. J. B. Costen.\(^1\)\(^-\)\(^3\) Dr. Costen discovered, perhaps quite by accident after referring many of his symptomatic, edentulous patients to a local dentist for new dentures, that many returned with their head and ear pain symptoms greatly relieved. His publications were positively received at the time and, in fact, what we refer to 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, over-closed patients do often exhibit some of the signs and symptoms commonly associated with TMD. Thus, although over-closure in and of itself is not pathognomonic of TMD, it should be considered as a risk factor.

The use of the patient's own muscles to determine the vertical dimension of occlusion was already being explored in the 1940s by people like orthodontist John R. Thompson.\(^4\) Sears\(^5\) introduced the concept of the "Pivot Appliance" in the 1950s, which was designed to open the bite enough to allow the patient’s muscles to
reposition the mandible. Following their lead, others\textsuperscript{6-28} have subsequently evolved the current array of neuromuscular registration methods presently in use. At the same time several studies\textsuperscript{29-32} have demonstrated that a muscle-determined position, although similar, is not identical to centric relation.

**Common Signs and Symptoms of 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 headaches 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) a measured freeway space greater than 3 mm, 2) EMG or visual identification of a tongue-thrust swallow, 3) the appearance of less than fully erupted molars, 4) a 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 (there is no scientific evidence that human teeth "grow out" in response to wear in the way that elephant's teeth do), 9) horizontal skin creasing and saliva weeping at the corners of the mouth, 10) a so-called "Shimbashi" measurement (in centric occlusion) of less than 16 mm from the cemento-enamel junction of the maxillary central incisor to the cemento-enamel junction of its opposing mandibular tooth and 11) long-term chronic internal derangement of the TMJ Joint(s). 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 reasons. 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 his/her 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. A 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 (ground off) [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 (cemento-enamel junction) to CEJ in C.O. < 16 mm. [less than the normal adaptive range]
12. Internal derangement(s) of the TMJ [if no degeneration, may be a successful adaptation]
Maxillo-mandibular Bite Relationships

Centric Occlusion (CO = habitual)

The maxillo-mandibular position of maximum intercuspsation 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 patients 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 patients 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 doesn't 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 temporomandibular joints. 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. This represents an approach that bridges the gap between strict CR and rigid MC approaches. Consequently, a variety of methods have evolved to capture and establish a muscle-related centric position, while maintaining favorable joint function.

**The requirements of proper 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 TM joint function prior to beginning the process. This can be accomplished quickly and easily with Joint Vibration Analysis (JVA see figure 1.), or with more expensive and invasive imaging such as MRI. Muscle relaxation can be aided by Ultra-Low Frequency TENS (ULF-TENS, see Figure 2.), an Aqualizer, soft music or any other technique that reduces the resting hyperactivity of the masticatory muscles. Surface electromyography (see figure 3.) is useful for making a quantitative determination whether relaxation has occurred or whether 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 the relaxed rest position of the mandible, with respect to the maxilla as a reference, a clinician can select a vertical dimension that allows adequate freeway space, yet avoids over-closing the bite. There are several methods currently used

* BioResearch, Inc. Milwaukee, WI
for selecting the treatment vertical. Each has its own rationale and advantages, but all of them benefit from objective diagnostic aids to ensure the best compromise between optimum joint, muscle, and tooth function.

**Several muscle-oriented bite registration techniques**

**The Wax Swallow Bite Registration**

A physiologic, muscle-oriented, vertical dimension can be obtained by means of the swallowing reflex technique originally proposed by the late 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 TM joint function with Joint Vibration Analysis or MRI.

**The 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 surfaces and the ULF-TENS is re-applied 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. There is a definite "technique sensitivity" to this procedure such that different operators tend to produce slightly to greatly different results. However, once the skill is developed, an operator may produce good consistency. These classic TENS bites ignored the TM joints function in the past, but this should no longer be the case. A final outcome with healthy TMJ's and muscles is our goal today.
The 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.

The 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. 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 very 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 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 the 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.
The 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 of 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. (Figure 5). 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 at try-in.
Figure 5. The position of the bite registration and the levels of muscle activity, are simultaneously visible in this combined EMG and jaw tracking recording. The vertical dimension is increased 2.5 millimeters, the freeway space is reduced from 4.1 mm to 1.6 mm.
Figure 6. Example of a patient with an overclosed vertical dimension, due to previous loss of teeth, that has been successfully treated using Neuromuscular Principles.

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 the 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 a patient’s adaptation to a new maxillo-mandibular relation. It is possible to estimate a patient’s response by considering the following factors:

1. The age of the patient [younger = more adaptive, older = less adaptive]

2. The amount of the change [a big change is more difficult to adapt to than a small change]

3. The duration of the overclosed condition [a long-standing condition will be more difficult to “de-program” than one of short duration]

4. The quality of bilateral TM joint 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.

An overclosed bite due to caries, loss of teeth, etc. without evidence of parafunction, typically coincides with a weak musculature, making adaptation difficult. This is very often the case with complete removable prosthetics.
Summary

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 re-establishing 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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If there’s one thing that’s guaranteed to get under the skin of every lab owner, it’s badly wrapped models that have been sent to the lab and have arrived in an inappropriate container and are now a mass of dust and pieces of a jigsaw, ready for the application of a liberal amount of Superglue.

Often it’s an absence of training for the person responsible for dispatch, as simple as it seems, properly wrapping models or impressions is not very common. Common sense is, after all, not very common.

Take away containers from the local Chinese restaurant are great for transporting the Friday night takeaway to your house, but as a container for dental models, they suck! We get 10-20 every week and they always arrive smashed to bits. They are very brittle. The contents within are in various stages of demolition. Using a take away container is only slightly better than no container at all (about 30 per week). I sometimes wonder if the person wrapping the models thinks the courier will carefully collect the satchel and sit it on his lap during the flight to the lab, and then hand deliver it himself. Nothing could be further from the truth.

Major courier companies collect thousands of satchels, sort them into destinations by throwing them into large bins and often have heavier satchels thrown on top of them. Unprotected satchels will be crushed. They are flown to the destination airport and re sorted by throwing them into other large bins. They are collected by van drivers who throw them into the van and deliver them to the destination. Write “Fragile” if you want, but it makes no difference.

I know you don’t want a call from the lab asking for another model. And I know your patient doesn’t want a call from your clinic to come in for another impression. It’s a waste of time and money for everyone involved. It doesn’t give your patient a positive impression of the practice.

Wrapping models and impressions correctly is very easy if you just follow a few rules. As I’ve said already, it’s just common sense, but it just isn’t happening too often.

Don’t laugh, but let me state the obvious, don’t put the lab sheet in the bag with impressions and wet tissue. They tend to become “One”, by the time we get them. If you are sending impressions, put them in a sealed (zip lock) plastic bag with some wet tissue if they are alginate, and double check the zip is fully zipped. Then staple the lab sheet to the bag. You don’t need to half fill the bag with water (yes it does happen, often).

If you are sending models, firstly check the model to make sure it’s good enough. By that I mean, no big air blows or voids, no teeth trimmed off by an enthusiastic assistant on the model trimmer, no broken or missing teeth and not a warped or dragged impression. Check particularly the molars as they are most often the teeth that are malformed due to
A dragged or voided impression. You will need to strike a balance between having enough impression material in the posterior region and too much material that would cause discomfort to the patient.

Once you are happy the model is good enough, write the patients name in pencil on the base. Then wrap each model individually with bubble wrap, put it in a plastic bag with the bite and then put all the cases you are sending in a box. Tape the box shut and put it in the courier satchel.

This is a VERY IMPORTANT POINT. Never ever send two models together in occlusion, even with a bite in between them. They are guaranteed to break several teeth.

When you receive cases back from the lab (I assume other labs do it similar to Ortholab) each model is wrapped in bubble wrap and put in a plastic bag in a box. You are expected to save the box (they are expensive to buy), the bag and the bubblewrap to use to send your next cases back to us. Recycle the wrapping material.

Buy yourself a roll of bubblewrap, it’s dirt cheap. Buy some sandwich bags, they’re cheap, and reuse the box. You are receiving the best wrapping material from the lab, just reuse it.

When all is said and done, I assume that you assume your staff know this stuff, after all it’s incredibly basic. But believe me, they don’t. Let them read this article or show them exactly how you want it done. The very best appliances can only be made on great models. I know you are sending great models, but by the time I get them in the lab, they are not so great.

We have put together a youtube video showing you how to wrap models, and another showing you how to pour models from impressions. They are available to view on our website, www.ortholab.com.au click on “Video Library”.

Graham Manley is the owner of Ortholab

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