Myocentric
A Clinical Appraisal

George A. Dinham

A clinical assessment of neuromuscular occlusal positioning with the Myo-monitor in 63 orthodontic patients.

KEY WORDS: CENTRIC RELATION, MYOCENTRIC, OCCLUSION

With the development of the Myo-monitor by JANKELSON (1975) about ten years ago, transcutaneous electrical neural stimulation (TENS) of the motor branches of the 5TH and 7TH cranial nerves became clinically usable. The objective of TENS was first to decondition or relax the mandibular and facial musculature in order to establish and identify the true mandibular rest position. Then, after the musculature was deconditioned or relaxed, the continuing impulses of the Myo-monitor could stimulate the musculature to raise the mandible from rest position through the interocclusal clearance (freeway space) to its correct vertical functional position.

A POSTULATE may be defined as an essential presupposition, condition, or premise. The following postulates are offered as a basis for a rationale for the concept of myocentric relationship.

1. The mandibular musculature is the dominant factor in mandibular positioning.
2. Free mandibular movements start from and return to rest position.
3. The rest position of the mandible is a resultant of a physiologic neuromuscular state which is unique for each individual.

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4. The rest position of the mandible is the most reliable starting point from which to evaluate mandibular movements.
5. The *true relaxed* rest position of the mandible may be different from the *apparent* rest position.
6. The mandibular musculature must be relaxed before a true rest position can be established.
7. The mandibular musculature can be relaxed by electrical transcutaneous neural stimulation to establish a true rest position.
8. Transcutaneous electrical neural stimulation can also be used to stimulate the relaxed mandibular musculature to raise the mandible from its true resting position through the interocclusal space to the *myocentric* position of the mandible.
9. The myocentric position of the mandible is the optimum neuromuscular relationship of the mandible to the skull with teeth in contact.

Most orthodontic casts are related by means of a tooth-guided wax bite registration. The patient is instructed to bite into a wax wafer which is used to orient the cast for trimming. The resultant static tooth-guided relationship is based on voluntary action by the patient, with or without mandibular guidance or manipulation by the orthodontist.

Such a relationship may or may not show the truly relaxed relationship of the mandible to the maxilla, depending on whether the mandible deviated from a normal path of closure to avoid tooth interferences in its closing path.

Some orthodontists feel that unmounted orthodontic casts can be inadequate or even misleading. Wood (1977) asked "What do these diagnostic tools tell us concerning the relationship of the mandible to the maxilla? Is this a *true* occlusal relationship? Could there be a more meaningful way to achieve the information necessary to make an accurate and functional diagnosis. . . ?" Roth (1973) stated that "It is obvious that currently used orthodontic diagnostic armamentarium do not relate the dentition to joint movement patterns on closure or during eccentric excursions." Graber (1961) has said "To relate casts in so-called centric occlusion is purely a static maneuver, arbitrarily selecting the terminal phase of the functional. . .cycle because of the mechanical interlocking." Thompson (1951) has stated "It is now realized that a proper diagnosis is impossible except in the simplest case by merely occluding upper and lower casts in the hand and looking at individual tooth relations. It is generally accepted that the occlusal position of the mandible may not be the desired functional position."

The key question is, what is the desired functional position?

Heide and Thorpe (1965) stated "The question arises whether the relationship of the unmounted, polished casts conventionally used for case analysis and treatment have any validity. To achieve proper relationship of the teeth with regard to correct temporo-mandibular position, the casts should be mounted on an articulator, utilizing the correct bite registration." What is a correct bite registration?

Brodie (1951) stated: "The final aid in diagnosis is a pair of carefully made plaster casts of the dental arches. These should be mounted in accurate relation to each other at the rest position to permit observation of the manner in which the jaw should close. This step will usually reveal any deflection of the mandible that is the result of a malposed tooth or teeth."

Determining rest position

Those who agree that rest position is a valid starting point from which to observe

mandibular movements find certain problems in registering rest position. Factors such as the patient's physical condition, anxiety, fatigue, muscle tone, posture and habitual functioning patterns make it difficult to register rest position with certainty.

BOMAN (1952) reported a change in rest position with change in posture. He stressed the importance of the head being in a natural posture when registering rest position.

PERRY (1956) said "Rightfully speaking, the patient with mandibular muscle spasm does not have a physiological rest position. In these patients as many different rest positions result as attempts to register it."

MCIVER (1959) reported on the difficulties and inaccuracies in using rest position, adding that after he had mounted casts in an articulator at what he thought was rest position, he still did not know how far to close the articulator to the correct vertical position of occlusion.

Boos (1954) recommended closing 2mm from rest to occlusion, but this arbitrary vertical position was merely the best educated guess that he could make with the instrumentation available at that time.

Myo-monitor stimulation

The Myo-monitor generates a negative rectangular wave. The negative polarity is critical for the ion flow through tissue. Intensity vs. duration curves have been established to maintain effective control of the stimulation of irritable muscles without excessive fatigue. Electrical specifications for the J-3 Myo-monitor with a fresh 9-volt battery and a standard dummy load approximating patient impedence are a pulse frequency of 1.5Sec, pulse width 500μSec and current $< 100\mu A$.

Jankelson called the position established by Myo-monitor stimulation the myocentric position. It is a spatial relationship of the mandible to the maxilla and skull in all planes. It is an involuntary position, a jaw-to-jaw relationship rather than a tooth-to-tooth relationship.

There is no voluntary action on the part of the patient or the dentist to guide the mandible into the myocentric position.

Those who believe in this concept of neuromuscular occlusion believe that myocentric is the optimum maxillomandibular relationship and represents the best possible functional mandibular position, most compatible with and least stressful to the patient's musculature.

JANKELSON (1975) reports on the action of the Myo- monitor: "With the introduction of the Myo-monitor to dentistry, the question has arisen whether the stimulus. . .is neurally mediated or results from direct depolarization of only the fibers of the masseter muscle. . . . These data tend support to the conclusions of CHOI AND MITANI (1973) that the Myo-monitor stimulates the fifth and seventh cranial nerves. . . . The data derived here correlate with those of other investigations and clearly establish that the transmission of the Myo-monitor stimulus is accomplished by transcutaneous neural stimulation."

JANKELSON AND RADKE (1978) further conclude that "the more advanced E.M.G. recording techniques of FUJII AND MITANI (1973) have shown clearly the neural mediation of the stimuli. . . . Thus the muscles responding to the Myo-monitor stimuli include all of the muscles of mastication and facial expression."

CRANE stated that "The autonomic, involuntary contractions produced by the Myo-monitor. . .essentially reproduce the physical and biochemical phenomena associated with normal muscle activity. The actions of the most direct benefit restore the localized function of the venous and lymphatic systems. . . . The con-

tractions induced by the Myo-monitor result in the same chemical changes as normal muscle activity. Principal among these are increased osmolality, decreased pO_2, increased pCO_2, increased hydrogen and potassium ion concentrations, and the production of adenosing compounds and lactic acid. The Myo-monitor restores muscle function in much the same way that normal contractions would, except that the normal function is inhibited by muscular accommodation to pain."

When maximum intercuspation (or centric occlusion) of artificial or natural teeth occurs at the myocentric position of the mandible, this is called myocentric occlusion. Failure of centric occlusion to coincide with the myocentric position of the mandible can be called myocentric malocclusion.

Functional examinations in the generic sense have been recommended before, during and after orthodontic treatment by several orthodontists. Among them are THOMPSON (1962), HEIDE AND THORPE (1965), INGERVALL (1976), AND PERRY (1976).

However, there is very little in orthodontic literature regarding the use of the myocentric position of the mandible as a basis for functional analysis. This is the reason for this evaluation of the application of the concept of neuromuscular occlusion and myocentric in clinical orthodontics before, during and after orthodontic treatment.

Method and materials

Diagnostic neuromuscular registrations were made for 63 orthodontic patients, and their casts were then mounted on articulators at the myocentric position. Additional registrations were made for 5 patients (before and after, or before and during treatment). In all, 68 registrations were made — 27 before treatment, 8 during treatment, and 33 after treatment.

Jankelson's neuromuscular registration technique was used, as follows:

- Accurate dental casts were made for each patient.
- The Myo-monitor was used to relax the mandibular musculature.
- The resulting rest position was clinically measured and recorded.
- A myoprint registration was made. A fast-setting acrylic myoprint material was placed over the occlusal surfaces of the mandibular teeth, while the patient stood in a relaxed natural posture. The action of the Myo- monitor stimulated the closing musculature of the mandible to raise the mandible from rest position into the myocentric position for the registration.
- The myoprint was removed from the mouth, placed between the casts and allowed to bench cure. Several myoprints were made to check the accuracy of the registration.
- The casts were mounted in a Hagman Junior Balancer articulator. Any articulator can be used, provided the mounted casts can move in all directions when related to each other.
- The mountings were checked for accuracy by using one or more of the myoprints to confirm that they were interchangeable with the myoprint which had been used for mounting.

Appraisal of the Procedure

Pretreatment registration

The questions to be resolved are —

1. Do you find out more about the problem? Does any added information justify the extra time and effort?
2. Does it help to decide whether to extract or not?
3. Should lateral cephalometric radiographs be taken with the mandible in the myocentric position?

1. Do you find out more?

In my opinion, using this procedure before treatment can be very valuable. Auxiliary personnel can prepare patients for registrations, reducing the extra chair time needed for several myoprint registrations to approximately one half-hour.

Casts mounted with this procedure are at least as useful as the usual orthodontic casts, and quite possibly much more so. One can more easily see interferences, lateral and anteroposterior shifts, and vertical problems.

PARKER (1978) emphasized the value of mounting casts on an articulator, saying that "At least the scope of the problem is clear for all to understand."

2. The extraction decision

Does this procedure help you to decide whether to extract or not in a given case? The possibility that decisions to extract teeth might be influenced by using this procedure before starting treatment was explored. In no case in this series of patients was the decision on extraction vs. non-extraction affected by information gained from mounting casts in myocentric.

Extraction decisions must still depend on the orthodontist's training, experience and judgment. However, one should remember THOMPSON'S (1972) comments about "maxillary extraction cases and congenitally missing maxillary lateral incisor cases. . .where. . .the maxillary incisors may be positioned too far lingually in the face for the mandible to assume its normal functional position after growth."

Functional analysis of these cases in the myocentric position before treatment could still be very valuable. If there is a possibility that single-arch extraction such as maxillary first bicuspids only, or closing spaces of missing lateral incisors, could contribute to a myocentric malocclusion, such procedures should be considered carefully.

3. Cephalometric radiographs

Most lateral radiographs are taken with the teeth in occlusion. HEIDE AND THORPE (1965) recommended taking lateral and frontal radiographs with the teeth in centric relation to avoid possibly misleading measurements.

Considering myocentric, the question was whether casts related by the usual tooth-guided bite registration might sometimes be unreliable or misleading, and whether myocentric would prove to be a more reliable maxillomandibular relationship.

The possibility of a diagnostic advantage in taking cephalometric radiographs with the mandible in the myocentric position was investigated in 14 cases. First, the usual lateral film was exposed with the teeth in occlusion; then the myoprint was inserted and the patient instructed to bite into this registration while a second film was exposed.

Tracings of the pairs of films, one made with the teeth in the usual occlusion, and the other with the mandible in myocentric position, were compared. Since only the mandibular position could change, and since the lateral view does not show lateral deviations of the mandible, only the anteroposterior and vertical differences are considered here.

A–N–B in the myocentric position was higher in 4 patients, lower in 4 patients, and unchanged in 6 patients.

Frankfort/mandibular plane angle was higher in 10 patients and unchanged in 4 patients.

The incisal edge of the mandibular central incisor was closer to the A–Pogonion line in 4 patients, farther from it in 7 patients, and unchanged in 3 patients.

All of the above differences were minor, amounting to only 1 or 2 degrees or millimeters. I could find no clinically significant differences, and even some of the small differences that were found could be the result of technical or tracing errors.

It appears that the differences are too small to provide any significant advantage in using the myocentric position for lateral cephalometric radiographs. This observation, based on these 14 cases, seems to agree with the conclusions of WILLIAMSON ET AL. (1978) in their study of cephalometric analyses based on films made with the teeth in maximum intercuspation compared with analyses based on films of the same patients with the mandible in centric relation.

Myocentric during treatment

Some orthodontists recommend that stage casts or progress casts be made routinely during treatment.

In this appraisal, additional myocentric registrations were not made routinely, but only on the basis of specific indications. For example, three patients developed TMJ dysfunction symptoms during treatment. Another had a lateral jaw displacement which did not respond to treatment. Functional analyses were used as an aid in the search for the cause of such symptoms.

Myocentric registrations were also made for several patients shortly before active appliances were removed. Arch wires and all active treatment forces should be discontinued at least a month before myocentric registrations are made, to allow the case to settle. Accurate dental casts can then be made and mounted in the myocentric position to determine whether additional treatment is needed. This procedure is valuable in checking arch correlations, closing deviation, lateral or anteroposterior displacements, dual bites, vertical discrepancies, and overall jaw relationships.

After treatment

Neuromuscular registrations were also made for 33 patients after active appliance therapy had been completed. Most of these patients were still under retention, but some had been without any appliances for several years. With their casts mounted in articulators at the myocentric position, some degree of *myocentric malocclusion* could be detected in all of them. Some were very close to the myocentric occlusal position, and others had mild malocclusions which were apparently well tolerated with no TMJ symptoms. These could usually be equilibrated.

There were also some more severe functional malocclusions that required further treatment with splints, bite plates or retaining appliances designed for minor tooth movements. According to the neuromuscular analysis, the teeth in these cases were too far from a myocentric occlusion for effective correction with equilibration alone.

Many of those cases would be considered acceptable as orthodontic results are usually judged. However, when they were subjected to a critical neuromuscular analysis certain functional discrepancies became apparent. Some of the more common discrepancies were:

- Incisal interference causing posterior mandibular displacement
- Excessive interincisal angles, usually associated with insufficient uprighting of incisors
- Excessive anterior vertical overbite
- Insufficient vertical height and lack of vertical support in the posterior areas when the mandible was at the myocentric position

• Poor arch form correlation when the mandible was in the myocentric position

• Various combinations of the above with posterior and/or lateral mandibular displacements

Some of those myocentric malocclusions were probably too minor for identification by examination of the usual orthodontic casts or by examination of the patient. These are often tolerated by the patient. However, when significant myocentric malocclusions are found, they should be treated (orthodontically, if possible) to establish an acceptable functional neuromuscular occlusion.

The analysis of this series of cases following treatment certainly confirms MILO HELLMAN'S 1921 statement that "perfect occlusion as conceived by the orthodontist is mythical." A/O

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