JT-20

Neuromuscular Aspects of Occlusion

Effects of Occlusal Position on the Physiology and Dysfunction of the Mandibular Musculature

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In the past the common criterion for evaluating the desirability of an occlusal position has been the mechanical repetitiveness with which the position can be registered. The concern for this criterion is understandable when one considers the problem that faces the clinician when he must decide on an occlusal position for the patient who has become edentulous on one or both arches, or who has had the crowns reduced for reconstruction, or who has an existing occlusion that is giving him problems of dysfunction and discomfort.

However, an even more important criterion for evaluating the desirability of an occlusal position is its effect on the neuromuscular apparatus. Unfortunately, mechanical measurement performed under conditions for registering condylar (border) occlusion does not establish whether the repetitiveness is occurring under muscularly relaxed or muscularly strained conditions. The presence of mechanical devices, such as clutches, central bearings, or pantographs, which have been used to measure border positions, elicit a neuromuscular response by their very presence. They so disrupt the musculature that no valid simultaneous information as to neuromuscular function or dysfunction can be derived under these conditions.

The major obstacle to the measurement of neuromuscular function and dysfunction has been a lack of the necessary high technological electronic measuring instruments capable of tracking mandibular movement and position with minimal neuromuscular disruption in large numbers of subjects. Such measuring instruments have only recently been developed and made available. Until now, many basic questions of function and dysfunction of the mandible, particularly the effect of occlusion on the neuromusculature, have remained factually unresolved.

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tracking mandibular movement.[3] The K5 Mandibular Kinesiograph (MKG) (Fig. 3) used in this investigation is a compact (26 lb) modular solid-state model capable of electronically tracking mandibular movement at the incisor point in three dimensions. It also monitors velocity. A companion model, the K3 Mandibular Kinesiograph, was also used to simultaneously track mandibular movement of two small magnets (1/15 oz) attached bilaterally in the molar regions.

Data retrieval is magnified up to 25 times and displayed on a cathode ray storage tube. A polaroid oscilloscope camera photographs the data for record. In addition to the cathode tube display, the research model (K5R) provides for optional data display on a paper strip chart recorder, or for storage/retrieval on magnetic tape. The instrument can also be directly interfaced with, and the data stored into, a digital computer (Fig. 4).

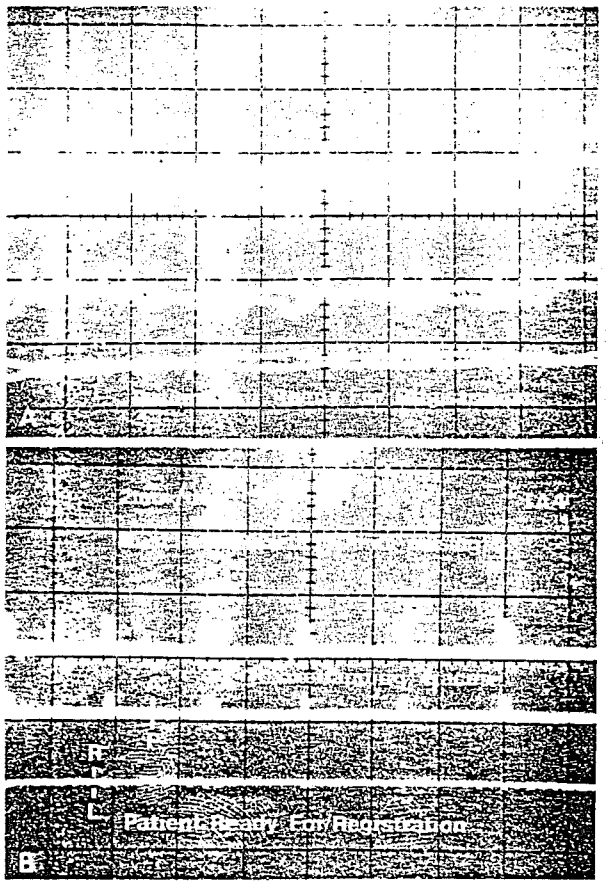

Figure 2. *A*. Muscle excitement before Myo-monitor. *B*. Muscle relaxation after Myo-monitor.

OCCLUSAL POSITION

Until recently, only two occlusal positions, centric occlusion and centric relation, have been generally recognized. Discussions of the desirability of occlusal position has ranged between the two —whether occlusion should be located at one, at the other, or at some position in between. A six-year study to determine the functional position of occlusion and the effect of the occlusal position on the neuromusculature comprised more than 400 subjects, recording over a 1000 swallows and over 20,000 chewing strokes.

To identify centric occlusion (intercuspal position), subjects were asked to "close and tap several times." The closure repetitively went to centric occlusion (Fig. 5).

To determine centric relation, various concepts and definitions were considered. They ranged from "the most retruded position of the condyles in the glenoid fossa at any given vertical, from which unstrained lateral movement can be made," to the more definitive absolutism of "*terminal* hinge position" and "*rearmost, uppermost, midmost position.*" Procedures for reaching the particular position advocated ranged from jiggling of the jaw to the application of pronounced force by the operator.

For the purposes of this investigation, retrusion by the patient's own musculature was selected, since realistically it would be the mechanism that would have to be used for attaining centric relation after the operator's hand was removed from the chin. Accordingly, after having registered the intercuspal position, the subjects were then re-

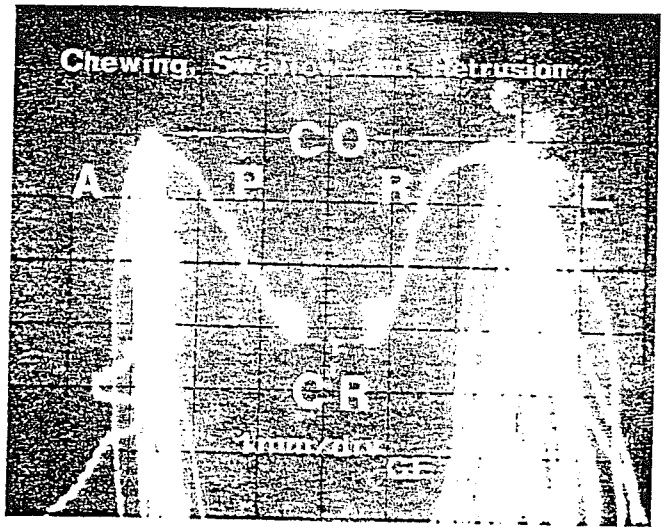

Figure 5. Simultaneous sagittal and frontal views. Chewing, swallowing, and retrusion to centric relation.

the validity of the concept of providing 0.5 to 1 mm of "long centric" on a bilaterally symmetric pathway on the same vertical level.

A kinesiographic comparison of muscle strain occurring at centric occlusion and centric relation shows the muscle strain characteristic of mandibular retrusion. Lateral and protrusive movements from centric occlusion are relatively free of tremor and strain (Fig. 7*A*), except when the subject is instructed to retrude to centric relation. The same subject was then instructed to retrude the mandible, hold in retrusion, and move to the right and to the left. (Fig. 7*B*). Strain and tremor, as the muscles attempt to move the mandible in eccentric excursions while maintaining retrusion, are evident. The data were confirmed by the tracings made in another experiment using a model K3A kinesio-

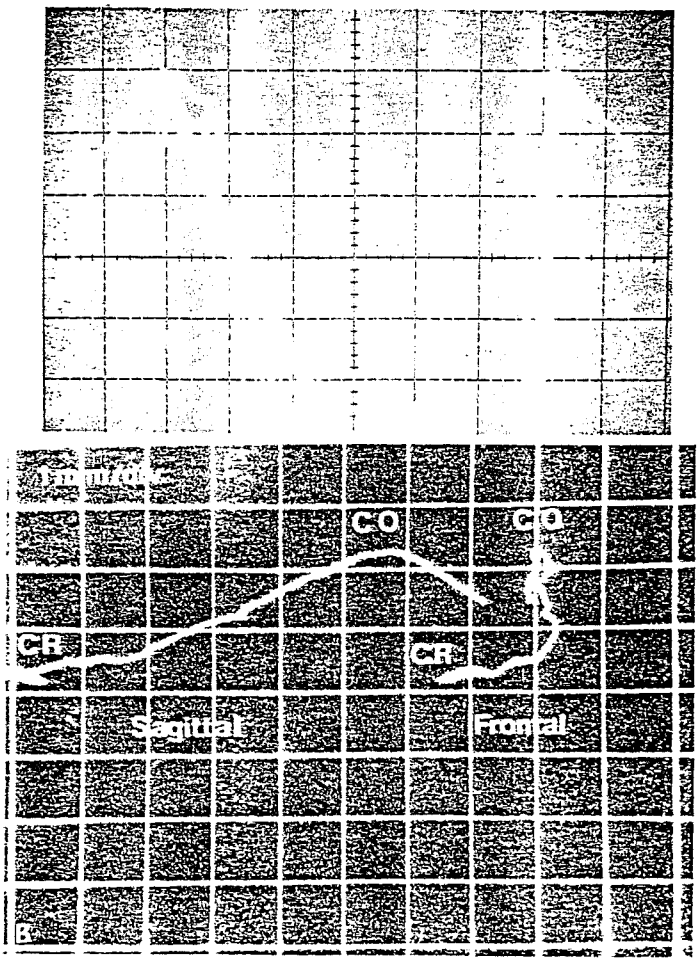

Figure 6. *A*, Short retrusion between centric occlusion and centric relation. *B*, Long retrusion between centric occlusion and centric relation (5 mm).

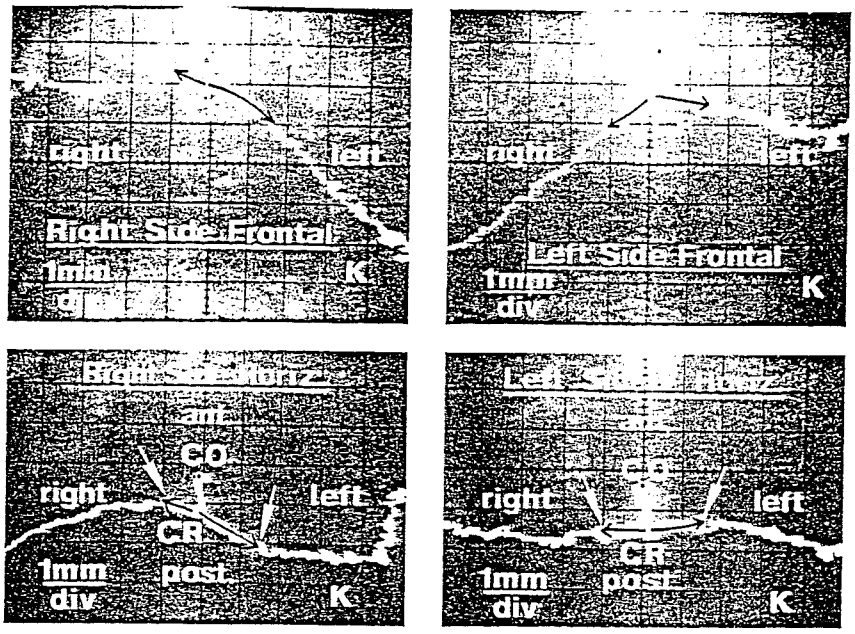

Figure 8. Lateral excursions manipulated from centric relation.

graph which tracks dual magnets attached to the molars of each side. Both voluntary and manipulated excursions from centric relation were extrapolated to the condyles by computer calculation. The strain during retrusion was also evident in these movements (Fig. 8).

These important findings are further supported by simultaneous mandibular kinesiographic and electromyographic studies of the effect on the neuromusculature of retrusion to centric relation (border position) done by Yamashita of Osaka Dental University (Fig. 9*A*). The muscle tension generated on retrusion from centric occlusion to centric relation gives further support to the findings that *centric relation represents a neuromuscularly strained position.* It is evident that positioning the mandible at centric relation iatrogenically induces neuromuscular imbalance and strain, with damaging side effects to the neuromusculature of the patient. The myocentric position, by contrast, shows little or no tension-producing demand upon the neuromusculature (Fig. 9*B*).

CENTRIC OCCLUSION

Centric occlusion can be described as the existing position of intercuspation. In no case in our investigation did it coincide with centric relation. The data also established that centric occlusion may coin-

occlusion dictates and maintains strained muscle accommodation, and an accommodative trajectory of closure. The result is mandible dysfunction characteristic of craniomandibular (TMJ) syndrome.

MYOCENTRIC OCCLUSION

Rest position is the clinical reference point from which myocentric occlusion is registered. *Myocentric occlusion* is that terminal point in space at which, with the mandible in rest position, subsequent isotonic muscle contraction raises the mandible through the interocclusal space along the myocentric (muscle balanced) trajectory. *Myocentric occlusion often coincides with centric occlusion, but in no instance was myocentric occlusion found to coincide with centric relation* (Fig. 10). The registration of myocentric occlusion can only be performed by balanced, relaxed neuromusculature. Myocentric occlusion cannot be registered in the presence of interfering clutches, protruding members, a pantograph apparatus, or manipulation or guidance by the dentist.

SUMMARY

Centric Relaxation. Muscle strain and tension are required to achieve retrusion to centric relation. The data show that the conventional gnathologic armamentarium and procedures used to achieve a mechanical occlusion based on a retruded border position program tension into the musculature. The procedures are incompatible with maintenance of a relaxed musculature.

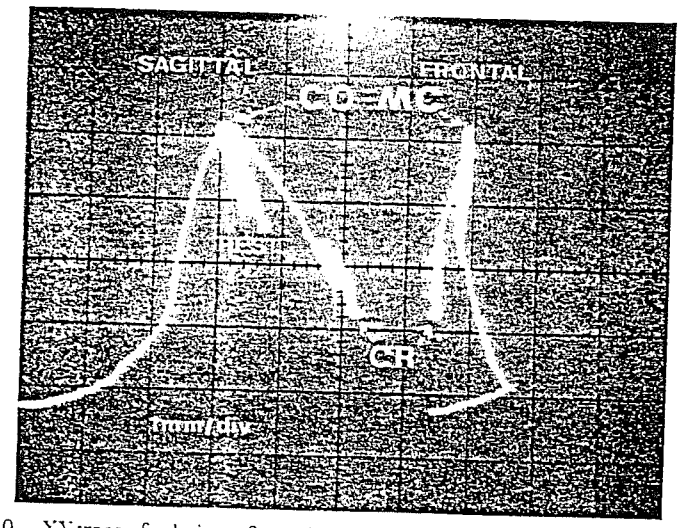

Figure 10. XY trace of relation of centric relation to myocentric and centric occlusion.