# A Longitudinal Study of Rest Position and Centric Occlusion

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## Introduction

What stability is exhibited by physiologic rest position and centric occlusion over an extended number of years? Studies tend to vary in their conclusions for these important factors. Boucher[1] defined physiologic rest position as the habitual, postural position of the mandible when the patient is resting comfortably in an upright position and the condyles are in a neutral, unstrained position in the glenoid fossae. The mandibular musculature is in a state of minimum tonic contraction to maintain posture and to overcome its force of gravity. According to Ramfjord and Ash,[2] centric occlusion is that position determined by the maximum intercuspation of the teeth, also called intercuspal position, tooth position, acquired centric, and habitual centric.

Posselt[3] stated that when an individual stands or sits in an upright position his mandible maintains a fairly stable position without contact between teeth. Except for minor changes with age, malocclusion, and loss of teeth, he felt relative stability of rest position should be accepted. Others[4] relate that rest position may not be constant at all times for all people, but rather that the position may be stable for most under normal conditions. Thompson and Brodie[5] published a paper on vertical dimension of rest in 1942. They suggested that form and proportions of the mandible are determined at an early age and that, once established, do not change. They told us that the position of the mandible in relation to the rest of the face and head is an integral part of the pattern of the individual and is just as unchangeable as is form. They went on to explain, ". . . rest position of the mandible is a result of a complex muscular co-ordination existing between the postcervical muscles and those groups lying anteriorly which are concerned with mastication, respiration, deglutition, and speech, acting as a unit they contribute to the balanced posture of the head." Furthermore, they felt that the proportions of any face should be constant throughout life and, most importantly, that if the mandible is forced to a position beyond physiologic rest, it will return to its original position through an accommodation of the alveolar process or a depression of teeth. Shohet[6] agreed with Thompson and Brodie and said that the effects of excessive bite opening should be apparent. The patient would complain of fatigue and pain in the muscles controlling the mandible. Since in such cases the muscles involved are stretched and therefore under terrific strain, the powerful force thus created will drive the teeth into their sockets or out of alignment. Serious disturbances to surrounding tissues will result. The injurious process will continue until normal freeway space has been restored.

Bahador and Higley,[7] Cowen and Marin,[8] and Kazis[9] all studied the problems involved with bite opening and cautioned those who would not

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respect physiologic limits. Trench,[10] Mershon,[11] Schuyler,[12] and Harris[13] warned that the dentist must be well-trained and familiar with the biological aspects when using extreme measures. They considered increasing the vertical dimension to be extreme. Harris felt that closed-bite conditions may be the result of lack of development or may be acquired through retrogressive changes in occlusion.

Niswonger[14] and Gillis[15] maintained rest position to be a result of co-ordinate equilibrium between levator and depressor muscles running to the mandible and that, in rest, the mandibular teeth are completely out of contact with the maxillary teeth. Niswonger, in 1934, was the first to intimate that a range for rest position was constant throughout life. Atwood,[16] in 1966, concluded that the postural position of the mandible is not a single, absolute position, but a range of positions. He also believed that variation may occur within the same individuals at different times.

Brodie, Downs, Goldstein, and Myer[17] noted a change in rest position of the mandible coincident to the correction of malocclusion. The mandible appeared to be positioned more posteriorly at the end of treatment in Class II cases. Schweitzer[18] related that lack of joint, muscle and cusp harmony must result in a physiological rest position of the mandible different from that assumed when everything is normal. He said if vertical dimension is increased beyond the normal distance the muscles will continue to contract until they regain normality. He stated, "Muscle is specialized tissue: it may be stretched and contracted; but once it reaches its full growth, it can't grow new muscle tissue." Thompson,[19-23] who has done exhaustive studies on rest position utilizing cephalometrics, advocates stability. Ricketts employed a lateral head roentgenographic technique and noted that the resting position represents an equilibrium of various forces, muscular and gravitational, and is reliable under stable conditions. However, the maintenance of the position of the mandible is a function of the proprioceptive system serving posture, occlusion, speech, deglutition, and respiration. So long as those functions and the parts that serve them remain unchanged the resting position of the mandible will remain unchanged.[24] Atwood[25] used the same technique in a study of forty-two patients and found that variability of rest was measurable. More recently others[26-28] have used cephalometrics in the study of facial vertical dimensions and have found it to be an efficient method.

Electromyography is an ideal procedure for determining rest position. The principle is based upon minute electrical discharges from muscle tissue. First reports in the literature concerning the phenomena of muscle-action potentials occurred in 1908.[29] Moyers[30] and Pruzansky[31] generally receive credit for initial application of electromyography to dental research. Jarabak[32] presented a paper in 1957 describing use of the technique in determining the rest position and mandibular movements related to it. He stated that when vertical dimension was excessive muscle tension increased. He also mentioned a zone of suppressed electromyographic activity in postural range of the mandible.

A unique method of registering mandibular positions using a combination of cephalometrics and electromyography has been developed. Mullen[33] reported that it is feasible to register postural position using cephalometric roentgenography in conjunction with electromyography. McMahon[34] and Hickey, Williams, and Woelfel[4] also examined rest position using the combination technique. They found rest po-

sition to be stable for most under normal conditions.

The present study was instituted to determine the degree of stability or instability of rest position and centric occlusion over a fifteen-year period.

## Methods and Materials

Sixteen dentulous dentists with random occlusions were recalled in 1973 for lateral cephalometric roentgenograms of rest position and centric occlusion. These were compared with their films made in 1958, 1959, and 1960. The records taken in this investigation were made in an identical manner and with the same cephalostat and electromyographic equipment used fifteen years before.

A tube-head to midsagittal plane distance of sixty inches was used for each subject. Three roentgenograms were taken, in rest position, in centric occlusion (maximum intercuspation), and one with the mouth completely open. The wide-open exposure allowed the head of the condyle to be readily seen and traced. Exposures were made for .5 second using 15 MA and 90KVP.

Prior to making each radiograph, rest position of the mandible was determined by using two techniques simultaneously. The first was electromyographically by the presence or absence of electrical activity from the middle fibers of the temporal and the anterior belly of the digastric muscles; secondly, by careful observation after having the patient say "m", swallowing, and relaxing. Each exposure was made while the subject demonstrated clinically that his mandible was in the postural position and while the electrical impulses from the muscles were at a minimum. It had been demonstrated previously that there is a tendency toward greater accuracy in determining rest position using both methods in combination rather than clinical observation only.[4]

Recordings were made on a six channel polygraph for pen recording, and, to increase the sensitivity, a cathode ray oscillograph (visual monitoring) with a high fidelity amplifier and speaker (aural monitoring). This plan allowed the electrical activity of the digastric muscle to be recorded simultaneously by the pen writer and aural monitoring system and the activity of the temporal muscle by the pen writer and visual system. Surface electrodes with electrode jelly were attached with adhesive tape to the cleansed skin overlying the muscles. The forehead served as the ground and the tip of the nose was the reference.

Lateral cephalometric head plates available from 1958 included the following: two rest position head plates, one with mouth wide open and one with the patient in centric occlusion. In 1959 and 1960, two rest position films were made each year. A medical and dental history was taken enabling an appraisal of the effect of any pathologies or treatment upon rest position or centric occlusion.

The most clear and readable roentgenogram for each subject was traced including bone trabecular patterns and the inferior alveolar canal of the mandible. Sella, nasion and menton were selected and a small pin hole was made through the tracing paper. This tracing was then used as a template on each of the succeeding roentgenograms superimposing on as many landmarks as possible. This included the technique advocated by Björk[35] of superimposing the inferior alveolar canal of the mandible and as many bony trabeculae as are visible. In this manner all measurements were made directly from the holes on each roentgenogram eliminating errors which could be made if nasion and menton were chosen on each film without a master template. Angular measurements were recorded

TABLE I

*Ranges of nasion-menton measurement in millimeters at rest*

| Subject | 1958-1960 (six rest positions) | 1973 (three rest positions) |
|---|---|---|
| 1 | 135-138 | 135-137 |
| 2 | 147.5-151 | 150-151 |
| 3 | 145.5-147 | 146.5-147 |
| 4 | 132-136 | 134.5-136 |
| 5 | 144.5-145 | 143.5-145* |
| 6 | 139-141 | 137.5-139 |
| 7 | 136.5-139 | 138-139 |
| 8 | 137-137.5 | 137-137.5 |
| 9 | 129-129.5 | 129-129 |
| 10 | 133-134 | 132-132.5 |
| 11 | 131-134 | 133.5-134 |
| 12 | 143-144 | 144-145 |
| 13 | 140.5-143 | 142-142 |
| 14 | 141-144.5 | 140-141 |
| 15 | 137-139 | 134-136 |
| 16 | 133.5-134 | 134.5-136* |

*Denotes those as more unstable in 1973 than in 1958-1960

TABLE II

*Changes in means between 1958-60 and 1973*

| Subj. | Nasion-Menton at rest | SNM | NSM | Mand. Pl.-SN |
|---|---|---|---|---|
| 1 | .9* | .2* | .4 | .3* |
| 2 | 1.6 | .1* | .6 | .3* |
| 3 | .7 | 0 | 0 | .6* |
| 4 | .6 | .1 | .1* | 1.0* |
| 5 | .4* | 0 | .2 | .2* |
| 6 | 1.7* | .2 | .7* | .6* |
| 7 | 1.0 | .7* | .7 | .3 |
| 8 | .1 | .3* | 0 | 0 |
| 9 | .3* | .2 | .1* | .6* |
| 10 | 1.3* | .2 | 1.1* | 1.5* |
| 11 | 1.0 | .4* | .4 | .8 |
| 12 | 1.1 | 0 | .1 | .1* |
| 13 | .3 | .8* | 1.0 | 1.3 |
| 14 | 1.5* | .5 | .3 | .8* |
| 15 | 4.1* | 1.4* | 1.4* | .9* |
| 16 | 1.3 | .4* | .6 | 1.0* |

*Denotes a decrease

to the nearest one-half degree using a standard protractor.[36] Linear measurements were made with a steel millimeter ruler to the nearest .5 millimeter. New templates were made for each subject and the following measurements made:

A. Linear
   1. Nasion to menton on rest position films.
   2. Nasion to menton with the patient in centric occlusion. This was done to determine if a vertical change had occurred in centric occlusion.
   3. Nasion to the incisal edge of the maxillary central incisor. This measurement was used as a control.

B. Angular
   1. Sella-nasion-menton (SNM)
   2. Nasion-sella-menton (NSM)
   3. Angle of the intersection of the mandibular and sella-nasion planes.

Table I compares the ranges of six rest position measurements (1958-1960) with the ranges of three rest position measurements made in 1973.

Since variation was so small, it was decided to average all the linear and angular measurements for each subject for 1958, 1959, and 1960. These mean figures are then referred to as the baseline for each category of measurement. This baseline was then compared with the mean of the three measurements for 1973 to ascertain if a difference had occurred in fifteen years. These data appear in Table II.

## Findings and Discussion

When using the term stable it seems necessary to define or qualify our exact meaning. *Webster's New World Dictionary* defines stable as: "resisting change; permanent; enduring."

We may put this definition to a number of applications. A particular point in space may be called stable or we may allude to a number of points in space as stable. The latter could be referred to as a range of points. Whichever term is used, it must meet the qualifications of our definition. When we speak of human physiologic functions, it seems logical to speak in terms

of ranges, such as a range of normal body temperatures or a range of normal blood pressures. When we measure rest position of the mandible, we are determining in reality a physiologic function of a number of muscles which control that position. Since it has been established that physiologic functions should be measured in ranges, it follows that we should accept the variable distances between two points as stable if they fall between the minimum distance and the maximum and continue to do so over an extended number of years.

The nasion-menton linear measurement with the patient at rest resulted in ten of the sixteen subjects having ranges in 1973 that were smaller or within their ranges established in 1958-1960 (Table I). The most stable subjects in 1958-1960 appeared to remain so in 1973. In fact, 14 of 16 appeared as consistent or more so in 1973 than 1958-1960.

The control measurement (nasion-incisal edge of the maxillary central incisor) indicated eleven subjects to have equal dimensions on all films. Four subjects had a variance of .5 millimeter and one had a control measurement two millimeters greater in 1973 than in 1958. This subject also had shown an increase of three millimeters in his vertical dimension of occlusion. A decision was made to select a new control measurement for that participant and all others whose vertical dimension of centric occlusion had increased. Nasion to the anterior nasal spine was chosen since the latter was clearly visible on both sets of roentgenograms. The new controls proved to be equal, thereby ruling out film distortion as the reason for the discrepancy.

It is well known in dentistry that if a tooth meets no resistance it will supra-erupt until resistance is met. Since the vertical dimension of centric occlusion had increased three millimeters in this patient, his maxillary central incisors could have lost contact with the opposing teeth and would subsequently erupt until contact was made. This would explain the two millimeter increase in the control measurement since it was determined by the maxillary central incisors.

The angular measurements (sella-nasion-menton, nasion-sella-menton and mandibular plane-sella nasion plane) varied very little between baseline and 1973 (Table II). The least variance was zero degrees and the greatest was 1.5.

The nasion-menton distance was measured with the patient in centric occlusion (maximum intercuspation) and indicated the following results: of the sixteen subjects, ten increased, two decreased 0.5 mm, and four remained the same. The increases ranged from .5 millimeter to 3 millimeters. All subjects had received some dental restorations. Vertical dimension of centric occlusion was increased or decreased in all cases which had a history of restorative work varying from single crowns or fixed bridges to removable partial dentures. Apparently, the amount of increase in each case was not enough to encroach upon the resting balance of the muscles since no change was noted in the rest position. There were also no signs of pathology such as pain or temporomandibular joint dysfunction when the subjects were questioned and examined by the author.

Rest position as determined in this study seems to be very stable for some subjects while others show a narrow range of stability, the determining factor being the degree of contraction of the muscle fibers that support the mandible. It should be noted that this contraction is influenced by proprioceptive receptors in the muscle itself (muscle

spindles), by emotions, and by proprioceptive fibers in the periodontal membrane.


## Summary

A fifteen-year longitudinal study of rest position and centric occlusion was done on sixteen dentulous subjects with random occlusions. In reviewing the literature the author could find no other investigation with this number of years interim. Records consisted of lateral cephalometric roentgenograms taken when the patient was in rest position and in centric occlusion. Rest position was determined by the patient saying "m" and swallowing, and electromyographically when the anterior belly of the digastric and the temporalis muscles elicited the least electrical activity. Both linear and angular measurements were made. The figures from 1958, 1959, and 1960 were averaged and compared with the mean of those taken in 1973. Rest position was found to have a small range of stability in all subjects, while the vertical dimension of centric occlusion increased in ten subjects, decreased in two, and remained the same in four.



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