Original Article

Cephalometric Evaluation of Maxillomandibular Relationships in Patients Wearing Complete Dentures: *A Pilot Study*

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Abstract: The purpose of this study was to evaluate the changes in vertical and sagittal maxillomandibular relationship of the patients who had been wearing dentures for an extensive period. Fifteen edentulous patients (seven men and eight women; mean age 63.5 years) who had worn dentures for six to 16 years (mean 10 years) were selected for this study. New prostheses were fabricated by conventional methods, and the patients were evaluated cephalometrically before and after the new prosthesis. The results were compared by Wilcoxon signed rank test ($P < .05$). Results indicated that a prognathic mandible and a pseudo Class III relationship with a reduced occlusal vertical dimension became a normal Class I maxillomandibular relation when the new prosthesis was inserted. A better facial profile was achieved. (*Angle Orthod* 2005;75:821–825.)

Key Words: Cephalometrics; Complete dentures; Maxillomandibular relationship

INTRODUCTION

Clinical observations document that some complete denture wearers suffer facial collapse as a result of severe occlusal wear of the artificial teeth, decreased occlusal vertical dimension, deterioration of the dentures, and residual ridge resorption.[1–8] The stomatognathic system adapts to the new maxillomandibular and occlusal relationships and continues to function. A patient's habitual maxillomandibular relationship may position the mandible forward to retain a poorly fitting, worn prosthesis and lead to the reduction of horizontal overlap. The facial appearance of these patients resembles a Class III relationship with a reduced occlusal vertical dimension, the clinician must decide whether this appearance results from a skeletal Class III relationship or is simply the result of denture wear and mandibular forward rotation and new dentures will correct the maxillomandibular relationship and facial collapse.[9,10] A few dentists have made attempts to use cephalometry as a diagnostic tool in prosthodontics to evaluate the results of prosthodontic rehabilitation.[7,11–13]

The purpose of this study was to evaluate cephalometrically the changes in the vertical and sagittal maxillomandibular relationship of patients who had worn full dentures for an extensive period of time and had the clinical appearance of a prognathic mandible similar to a skeletal Class III relationship.

MATERIALS AND METHODS

Fifteen edentulous patients (seven men and eight women; age range 45 to 83 years; mean age 63.5 years) who presented to the clinic of the Department of Prosthodontics, Faculty of Dentistry, Hacettepe University, seeking complete denture treatment were selected for this study. Patients were selected randomly to participate in this study. The patients had used their dentures for between six and 16 years and they were dissatisfied with their ability to function acceptably (Figure 1).

The selected patients had severe residual ridge resorption, worn dentures, facial collapse because of the diminished vertical dimension, and a pseudo Class III appearance. The new prostheses were constructed for each patient using a semiadjustable articulator (Whip Mix Corp, Louisville, Ky). Final impressions were made with Zinc oxide/eugenol (Coe-Flo impression cream, Coe Laboratories Inc, Chicago, Ill) using man-

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FIGURE 1. (A) Patient wearing previous dentures.

FIGURE 1. (B) Patient wearing new dentures.

dibular and maxillary acrylic trays formed over selected spacers. Wax occlusion rims were added and maxillomandibular relationships were established.

The rest position of the mandible was determined by using the distance between two arbitrarily selected points, one on the nose and one on the chin, with the patient seated in an upright position looking directly forward, head unsupported, after swallowing. Then the patient was instructed to close the mandible until the lips first touch. The distance is measured, and these measurements are compared with the measurements made between these points when the artificial teeth are tried in. This method was first described by Niswonger and is still used by many practitioners.[14,15] The occlusal vertical dimension was established by subtracting three to four mm from the rest position. Centric relation was recorded using Aluwax (Aluwax Dental products, Grand Rapids, Mich) and guided closure with bilateral manipulation against the notched opposing wax rim. Then the denture bases were mounted on an articulator. After trial placement, the dentures were processed with a heat-curing acrylic resin denture base material (Acron Standard, GC Corporation Tokyo, Japan) for nine hours at 165°F. Because the patients had been habitually functioning in a protrusive position due to diminished vertical dimension, care was taken while recording the correct vertical dimension because this record remains one of the more variable measurements in clinical practice for complete denture prostheses.

Using the same cephalometric unit (Planmeca-PM 2002 CC Proline; Planmeca Oy, Helsinki, Finland), standardized lateral cephalometric headfilms were made on each patient, both with the old denture in place and with the new one in place. All headfilms were taken with the patients standing and in natural head position with the teeth in centric occlusion and lips together.

The lateral cephalograms were digitized and analyzed using computer software (Rocky Mountain Orthodontics [RMO], Denver, Colo) Jiffy Orthodontic Evaluation JOE Version 5.0 cephalometric program (Diagnostic Services, Canoga Park, Calif) (Figures 2 through 4). Values reported were calculated by subtracting the before new denture value from the after new denture measurement for each parameter. Retraction of the lips relative to the E line was assigned negative values because measurements to the left of the reference lines were recorded as negatives. For example, a typical change for lower lip to E line would be recorded as $(-5) - (-1) = -4$. The values obtained were compared by Wilcoxon signed rank test. Statistical significance was set at $P < .05$. The values were not averaged. SPSS 10.0 software was used for statistical analysis of all data.

RESULTS

Table 1 shows the comparison of the clinical results and the mean cephalometric measurements. The prognathic mandibular appearance of the patients became normal maxillomandibular relationships and appeared Class I. After the placement of the new dentures, the vertical dimension was increased statistically. Lower facial height angle changed from 40.9° ± 3.9 to 45° ± 6.7 after the new prostheses were inserted ($P < .05$). ANS-Me distance was increased from 58.5° ± 11.9 to 64.1° ± 13.9 ($P < .5$). SNB angle (before

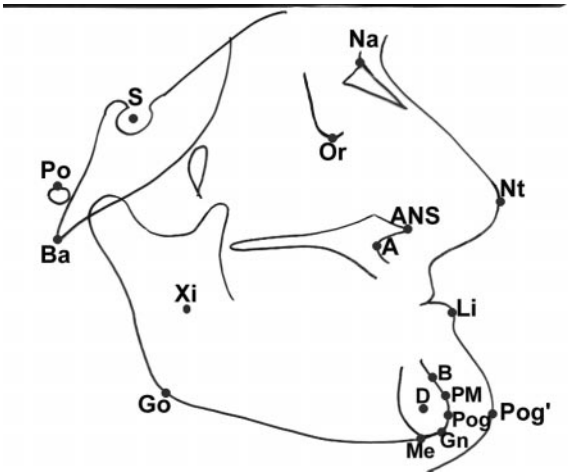

FIGURE 2. Definition of cephalometric points—Na: nasion, the most anterior point of the frontonasal suture in the median plane; S: sella, the point representing the midpoint of the pituitary fossa (sella turcica); A: point A, the point at the deepest midline concavity on the maxilla between the anterior nasal spine and prosthion; B: point B, the point at the deepest midline concavity on the mandibular symphysis between infradentale and pogonion; D: point D, the geometric center of the symphysis; Or: orbitale, the lowest point in the inferior margin of the orbit; Po: porion, the superior point of the external auditory meatus; Pog: pogonion, the most anterior point of the bony chin in the median plane; ANS: anterior nasal spine, the tip of the bony anterior nasal spine, in the median plane (unilateral) it corresponds to the anthropological acanthion; Gn: gnathion, the most anteroinferior point on the symphysis of the chin, it is constructed by intersecting a line drawn perpendicular to the line connecting Me and Pog; Go: gonion, the constructed point of intersection of the ramus plane and mandibular plane; Ba: basion, most inferior point of the occipital bone; PM: protuberance menti point selected at the anterior border of the symphysis between point B and pogonion where the curvature changes from concave to convex; Me: menton, the most inferior midline point on the mandibular symphysis (unilateral); Xi: Xi point, the geometric center of the ramus of the mandible; Nt: nose tip, the most anterior point on the sagittal contour of the nose; Pog: soft-tissue pogonion, the most anterior point on the soft-tissue chin; Li: labrale inferior, the most anterior point on the convexity of the lower lip.

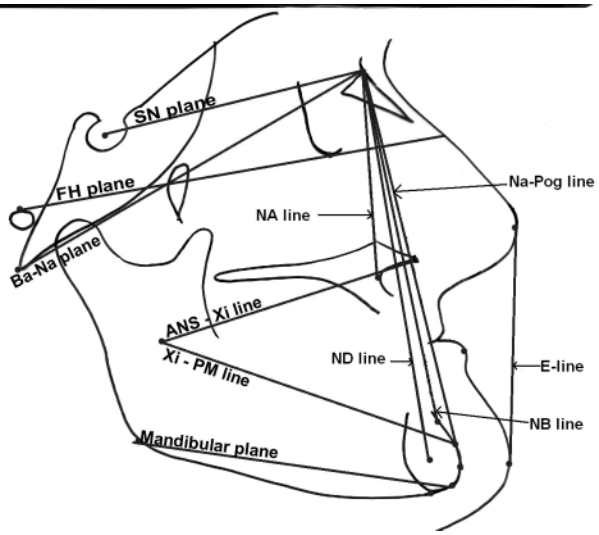

FIGURE 3. Description of reference lines—mandibular plane: the line drawn by the intersection of gonion and gnathion points; Frankfurt horizontal plane (FH Plane): a horizontal plane running through the porion and orbitale; SN plane: the line drawn by the intersection of sella and nasion points; Ba-Na plane: horizontal plane running through the basion and nasion; NA line: line extending between nasion and point A; NB line; line extending between nasion and point B; ND line; line extending between nasion and point D; Na-Pog line: line extending between nasion and Pog; ANS-Xi line: line extending between ANS and Xi; Corpus Axis (Xi-PM): line is drawn from Xi point to PM; E-line: esthetic line extending between Nt and Pog.

84.7° ± 4, after 82.5° ± 3.7), SND angle (before 83.4° ± 4, after 81° ± 4), and the facial depth angle (before 93.8° ± 3.2, after 90.5° ± 2.6) decreased significantly ($P < .05$) because of the increase in vertical dimension (Table 1).

DISCUSSION

Cephalometric analysis has served for many years as a valuable adjunct to dental research and diagnosis. Although its clinical application has been directed largely toward orthodontics, one of the most useful applications of cephalometry for prosthodontic reconstruction is that it can be used to reestablish the spatial position of lost structures such as the teeth. This is achieved by identifying predictable relationships between the teeth and other cranial landmarks that are not subject to postextraction changes. Such a relationship has been shown to exist between the angle of the occlusal plane relative to the Frankfort Horizontal plane on the one hand and the angle between the cephalometric points porion, nasion, and anterior nasal spine (the PoNANS angle) on the other. Where the natural occlusion has been lost, orientation of the occlusal plane can be reconstructed by measuring the PoNANS angle cephalometrically.[11–13,16]

After the prosthesis was inserted, the accuracy of vertical dimension was tested using phonetic methods. When the patient repeats the words Emma and Mississippi, the teeth should not contact. The interocclusal distance has been found to be an extremely critical dimension because it relates to both the patient's comfort and the functioning of his dentures. If the interocclusal distance is too great, then the vertical dimension of occlusion is insufficient. This means that when the patient closes to the vertical dimension of occlusion, the patient will give the appearance of having his chin too close to his nose. The patient takes on a characteristic denture look caused by the sagging of the lower face.[14,15]

The habitual maxillomandibular relationship of patients using complete dentures for a long time typically positions the mandible forward to retain the poorly fitting, worn prosthesis. Clinically, this appears like an

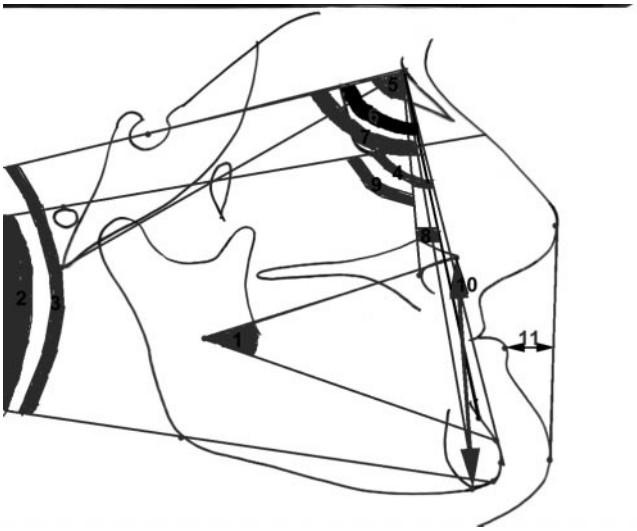

FIGURE 4. Description of cephalometric measurements. (1) Lower facial height angle, the angle formed by the intersection of ANS-Xi line and Xi-PM line; (2) FMA angle, the angle form by the intersection of Frankfort horizontal plane and mandibular plane; (3) gonion gnathion-SN angle, the angle between mandibular plane and SN line; (4) facial depth angle, the angle formed by the intersection of Frankfort horizontal line and Na-Pog line; (5) SNA angle, the angle formed by the intersection of SN plane and NA plane; (6) SNB angle, the angle formed by the intersection of SN plane and NB plane; (7) SND angle, the angle formed by the intersection of SN plane and ND plane; (8) ANB angle, the angle formed by the intersection of NA plane and NB plane; (9) maxillary depth angle, the angle between Ba-Na plane and NA plane; (10) ANS-Me, the distance between ANS and Menton points; and (11) lower lip-E plane, the distance between Li and esthetic plane. SNA angle and maxillary depth angle: show the position of the maxilla to skull base. SNB angle, SND angle, and facial depth angle: show the position of the mandible to skull base. Lower facial height angle, mandibular plane-FH plane angle, goniongnathion-SN angle, and ANS-Me distance: show the vertical plane changes of mandible. ANB angle: shows the relation of maxilla and mandible to each other. Lower lip-E line: shows the procumbency of lower lip.

orthodontic Class III relationship with a reduced occlusal vertical dimension and forward positioning of the mandible. The decrease in the occlusal vertical dimension may result in trauma at the articular fossa associated with pain, discomfort, clicks, and headache.[10,14,17,18]

After the reconstruction of new dentures, the mandibular plane-Frankfort horizontal angle, GoGn-SN angle, and ANS-Me distance also increased statistically significantly ($P < .05$) (Table 1).

The mandibular prognathism in relation to the cranial base, as determined from the facial depth angle, SNB angle, and SND angles, decreased significantly ($P < .05$) (Table 1). The facial depth angle decreased from 93.8° to 90.5°, the SNB angle decreased from 84.7° to 82.5°, both showing the retruded mandible resulting from the fabrication of a new denture. The posterior rotation of the mandible, noted on the completion of the prosthetic treatment, was accompanied by a statistically significant decrease ($P < .05$) in mandibular prognathism. The findings indicated that as expected there had been no change in the maxillary structures. There were no significant changes in SNA angle and maxillary depth angles ($P > .05$) (Table 1). This is a pilot study because the sample size is too small and further study is recommended with a sample of larger size.

In the literature, there is limited data that is similar to our study and that we can discuss with our results. For example, Tallgren et al[8] used cephalometry to study the soft tissue profile of the patients during a two-year period of denture use. Also, Sofou et al[16] used acrylic resin blocks on the mandibular posterior bases instead of denture teeth to stabilize the mandibular relationship. After 4–8 months of stabilization, dentures were completed using mandibular posterior teeth. Monteith[12,19] used cephalometry to determine the angulation of the occlusal plane in edentulous patients.

TABLE 1. Changes in Cephalometric Variables

Cephalometric Variable	Before New Prosthesis	After New Prosthesis	*P*
Lower facial height angle	40.9 ± 3.9	45 ± 6.7	.012*
ANS-Me (mm)	58.5 ± 11.9	64.1 ± 13.9	.012*
Mandibular plane-Frankfort horizontal angle	16.5 ± 5.2	21.4 ± 4.9	.012*
Gonion gnathion-SN angle	23.2 ± 6.5	27.7 ± 7.1	.012*
Facial depth angle	93.8 ± 3.2	90.5 ± 2.6	.012*
SNA angle	81.6 ± 1.5	82.6 ± 1.6	.208
SNB angle	84.7 ± 4	82.5 ± 3.7	.012*
SND angle	83.4 ± 4	81 ± 4	.011*
ANB angle	−2 ± 3.5	−0.5 ± 3.3	.141
Lower lip-E plane (mm)	−7 ± 3	−5.8 ± 3.4	.327
Maxillary depth angle	88.7 ± 3.6	88.4 ± 3.2	.204

CONCLUSIONS

The severe loss of occlusal vertical dimension coupled with a habitually protruded mandible resulting from the long-term use of the same complete dentures was corrected by a newly fabricated denture that allowed maximum freedom of mandibular movements. The patients also gained their profile esthetics by the increase of vertical dimension. The lower facial height angle, mandibular plane-Frankfort horizontal angle, and GoGn-SN angle were used as the main determinates of vertical dimension and were increased in the patients.

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