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CLINICAL RESEARCH

A craniometry-based predictive model to determine occlusal vertical dimension

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ABSTRACT

Statement of problem. Craniometry is a method of determining the occlusal vertical dimension (OVD); the current prediction models do not consider factors such as facial type and sex or normalizing the OVD by using 1 main variable.

Purpose. The purpose of this clinical study was to determine whether sex, facial type, and age can influence the creation of a predictive model by using the right or left eye-to-ear distance to determine the OVD in dentate and edentate individuals.

Material and methods. Healthy individuals (N=385) (238 women, 147 men) aged between 18 and 50 years were classified according to sex, age, and facial type. A single operator recorded all distances in millimeters between the anatomic landmarks proposed by Knebleman (nose-to-chin and right and left eye-to-ear distances) by using a computer numerical control (CNC) machined aluminum anatomic gauge. Measurements were converted into z-scores to determine abnormal values (±3 standard deviations criteria). The Pearson correlation coefficient was calculated for each facial type and for the entire sample between nose-to-chin and the right and left eye-to-ear distances. Multiple regression analysis was performed to establish the dependence of the measured variables on the OVD and the development of a further predictive model (α=.05).

Results. According to the z-scores of the measured distances, 4 participants were discarded, leaving a final sample of 381 participants (237 women, 144 men; 115 leptoprosopic, 164 mesoprosopic, 102 euryprosopic). The left eye-to-ear distance showed a better correlation with the nose-to-chin distance (leptoprosopic r=0.54, mesoprosopic r=0.60, euryprosopic r=0.55, total sample=0.56) than the right eye-to-ear distance (leptoprosopic r=0.48, mesoprosopic r=0.56, euryprosopic r=0.54, total sample=0.51). Multiple regression analysis revealed that age was not a predictive variable (*P*=.57), that OVD depended on sex (*P*<.001) and facial type (*P*<.01), and that women had shorter OVD than men, as well as more euryprosopic faces than leptoprosopic faces. Using these relationships, the following equation to determine OVD was constructed as a model: OVD=42.17+(0.46×left eye-to-ear distance)+sex (women=−3.38, men=0)+facial type (leptoprosopic=0, mesoprosopic=−1.19, euryprosopic=−2.19).

Conclusions. OVD depends on facial type and sex, both of which are craniometric variables. This study proposed a baseline method of determining OVD by using the left eye-to-ear distance as an initial reference that involves a straightforward mathematical calculation. (J Prosthet Dent 2020;123:611-7)

The occlusal vertical dimension (OVD) is the distance between 2 selected points—usually on the chin and the tip of the nose—with the teeth in maximum intercuspation.[1] Determining the correct OVD is important when restoring dentitions in which loss or change of posterior dental support has occurred. In such situations, restoring the OVD is essential given its effect on esthetics, neuromusculature, and biomechanical behavior.[2-5] Moreno-Hay and Okeson[6] pointed out that scientific evidence that alterations in OVD cause temporomandibular disorders in the long term is lacking. However, they suggested that any changes in the OVD should be minimal.[6]

Different techniques to determine OVD have been described, including mandibular physiologic rest position,[7] esthetics,[8] phonetics,[9] and deglutition.[10] These techniques rely on the clinical

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Clinical Implications

Determining OVD by sex and facial type is possible by using a straightforward mathematical equation with the left eye-to-ear distance. OVD in women is shorter than in men and in euryprosopic faces. There is a maximum difference of 5.5 mm for the same eye-to-ear distance but with different combinations of sex and face type. Therefore, the craniometric model for determining the OVD should be a valid, objective, and specific baseline method, requiring relatively little clinical time.

criteria of the clinician and the cooperation of the patient, which leads to variability.[11]

More objective techniques have been described based on craniometrics,[12,13] cephalometric studies,[14-17] facial proportions,[18,19] and preextraction methods.[20-22] As these techniques are based on the analysis of morphologic relationships, which can be observed and quantified, their variability should be lower.

Knebelman[23] described a craniometric method and proposed a proportional relationship between the distance from the anterior wall of the external auditory meatus to the medial aspect of the lateral wall of the right orbit (eye-to-ear distance) and the distance from the lower surface of the anterior nasal spine to the most anterior and inferior point of the mandible with the teeth in occlusion (nose-to-chin distance). The patent[23] indicated that such relationship is adjusted to a factor dependent on cranial size, for each millimeter increment of the eye-to-ear measurement (made between 60 and 80 mm), a deduction of 0.1 mm is made, starting with −5 mm when the eye-to-ear measurement is 60 mm to a low of −3.0 mm when the eye-to-ear measurement is 80 mm. The technique has been described as a straightforward, inexpensive, and noninvasive method that can be used for determining OVD.[12,24] However, the predictability of the method varies depending on sex, side of the face measured, and ethnicity.[12,24] In addition, Manns et al[25] reported that, given the possible differences in muscular pattern displayed by different biotypes, facial biotype should be considered when the OVD is restored.

The Knebelman method of predicting OVD takes only 1 variable into account. The purpose of this clinical study was to determine whether the variables of sex, facial type, and age can influence the determination of the OVD by using the right or left eye-to-ear distance as an indicator to predict the OVD in dentate and edentate individuals. The research hypothesis of this clinical study was that a correlation would be found between OVD and the eye-to-ear distance, depending on the variables of sex, age, and facial type.

MATERIAL AND METHODS

Participants aged between 18 and 50 years were voluntarily recruited from patients and employees of the INDISA Clinic (Santiago, Chile) to participate in this clinical study between May 2016 and August 2016; 238 women (average age ±standard deviation 32.5 ±7.52 years) and 147 men (average age 32.1 ±7.54 years). This study was approved by the ethics committee (East Metropolitan Healthcare Service). All participants gave their informed written consent to take part in this research in accordance with the Declaration of Helsinki.

The participants were enrolled by a single researcher (C.M.) by using a questionnaire and visual inspection to ensure the following inclusion and exclusion criteria were fulfilled. The inclusion criteria are as follows: healthy, fully, or partially dentate (with no more than 2 missing teeth, apart from third molars) adults with stable maximum intercuspal position and bilateral posterior support and without any temporomandibular skeletomuscular symptoms. The exclusion criteria are as follows: developmental maxillofacial anomalies; tooth wear with dentin exposure; facial features precluding correctly locating anatomic landmarks and making accurate measurements; dense beards; parafunction; ongoing or past orthodontic treatment; acute ear conditions; skeletal class III malocclusion; and edentulism.

After the participants had been selected, they were classified according to sex, age, and facial type, and their craniometric measurements were recorded. This was performed by the same single researcher (C.M.). The overall morphological facial index[26] (FI) was used to determine the facial type. The FI was calculated by using the following formula: $FI=100\times(FH/FW)$, where facial height (FH) is the distance between the glabella (the point situated on the midline between the supraorbital arches) and the gnathion (the most antero-inferior point of the mandibular symphysis) and facial width (FW) is the bizygomatic distance (zygion to zygion).

Digital calipers (Ubermann) were used to measure all distances. The participants were seated on a chair with their backs upright against the back of the chair, with their heads unsupported and looking straight ahead and with the plane of Camper parallel to the floor. The operator sat on a rolling stool at the same height as each participant and recorded all measurements to calculate the FI. Having calculated the FI, participants were divided into euryprosopic (FI<97), mesoprosopic (FI 97-104), and leptoprosopic (FI>104). Their facial type, sex, and age were recorded on a spreadsheet (Excel; Microsoft Corp).

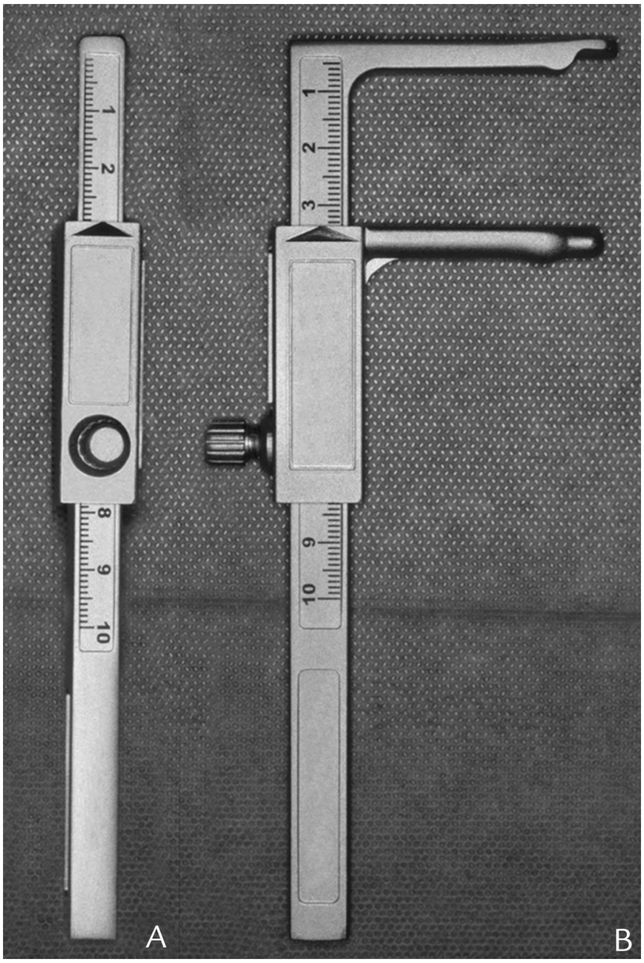

Figure 1. Calipers used to record eye-to-ear distance A, Lateral view. B, Front view showing part of calipers used to record nose-to-chin distance.

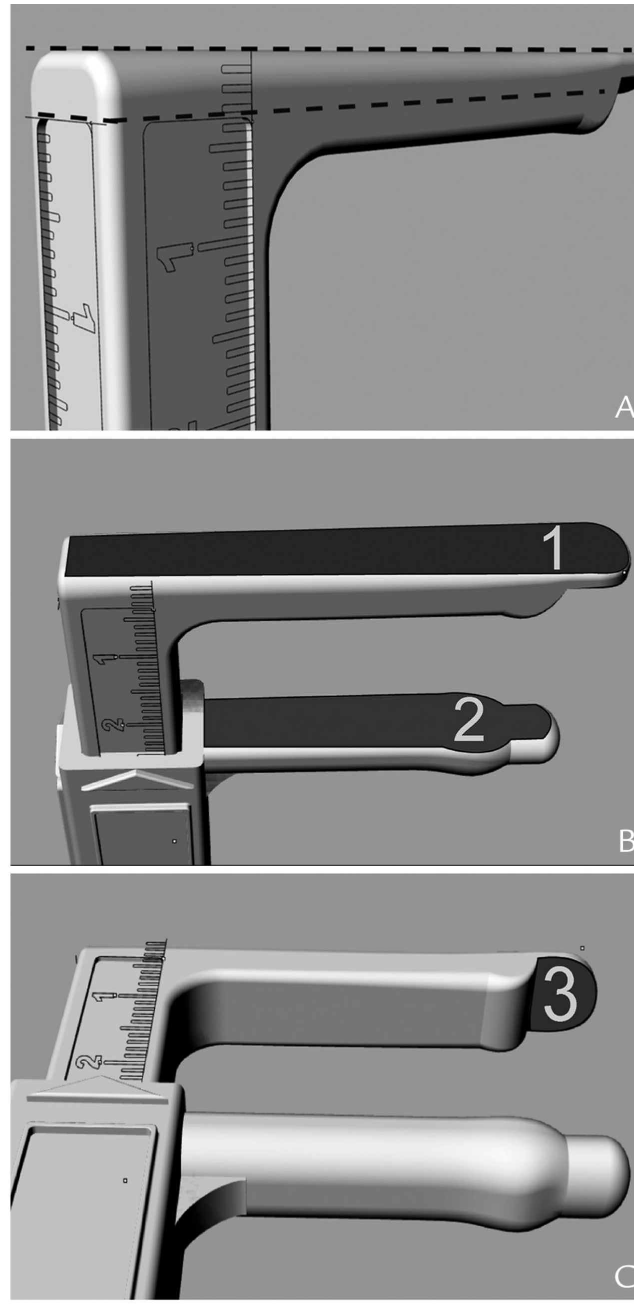

Figure 2. A, Range and location of zero mark of calipers. B, C, Surfaces that contact anatomic structures when recording eye-to-ear distance (3, 2) and nose-to-chin distance (1, 2).

Distances between those anatomic landmarks considered to be predictive in determining the OVD according to the craniometric method of Knebelman were subsequently recorded for all participants: right and left eye-to-ear distance (the distance between the medial aspect of the lateral wall of the orbit and the anterior wall of the external auditory meatus) and OVD (the distance between the lower surface of the anterior nasal spine and the most anterior and inferior point of the mandible with the teeth in occlusion).

The researcher, trained according to the protocol created by Knebelman, performed and recorded all craniometric measurements by using a computer numerical control (CNC) machined anodized aluminum anatomic measuring device calibrated in millimeters with laser-engraved graduations. The device was designed by using software (Rhinoceros 3D; Robert McNeel & Associates) with a scale on the front surface to measure the nose-to-chin distance and a scale on the lateral surface to measure the eye-to-ear distance (Fig. 1). For each of the 2 scales, the zero mark was located on the surface of the calipers that would contact the corresponding anatomic landmarks for measuring the eye-to-ear and nose-to-chin distances in turn (Fig. 2).

Using the protocol of Knebelman,[23] measurements were recorded with both participant and operator in the setting described previously to classify facial type. The tip of the lower arm of the device was placed onto the anterior wall of the right external auditory meatus,

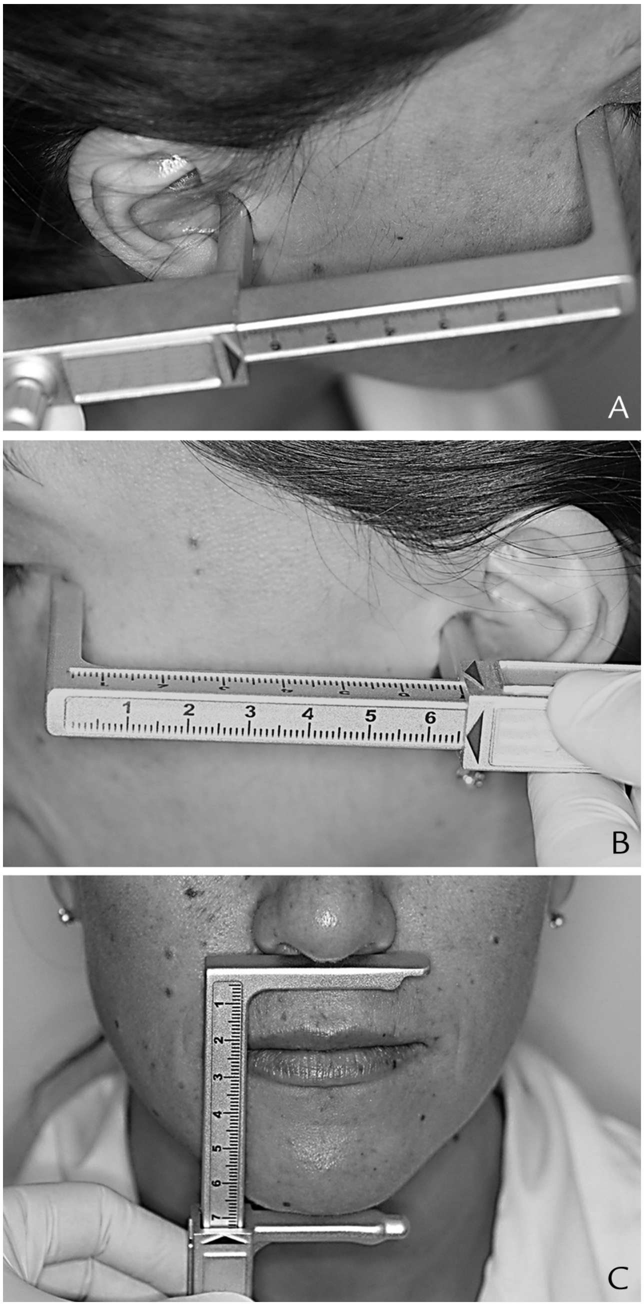

Figure 3. Recording distances. A, Right eye-to-ear distance. B, Left eye-to-ear distance. C, Nose-to-chin distance.

perpendicular to the sagittal plane of the cranium; the end of the upper arm of the device was placed against the medial aspect of the lateral wall of the right orbit (Fig. 3A). Measurements were made with minimal pressure to avoid excessive compression of anatomic structures and discomfort. The fixing screw was tightened, and the reading (in millimeters) on the device for eye-to-ear distance was recorded. The same procedure was performed for the left-hand side of the cranium (Fig. 3B). Subsequently, the participants were asked to bring their posterior teeth together without occluding hard to achieve maximum intercuspation. The nose-to-chin distance (OVD) was then recorded, with the upper side of the upper arm of the calipers placed against the lower surface of the anterior nasal spine. In turn, the upper side of the lower arm of the device was positioned on the most anterior and inferior surface of the mandible (Fig. 3C). The fixing screw was then tightened, and the reading displayed on the device was recorded in millimeters. All measurements were recorded on the spreadsheet (Excel; Microsoft Corp).

Qualitative variables were described as frequencies and percentages. Continuous variables were analyzed by using quartiles, averages, and standard deviations. Distance measurements were converted into standard scores (z-scores) with the purpose of identifying measurements outside a normal range. The distance criteria for this were ±3 standard deviations from the arithmetic mean of recorded distances. This was done for each facial type according to their FI. The Pearson correlation coefficient was calculated between the nose-to-chin distance and the right and left eye-to-ear distances for each facial type and for the entire sample. Subsequently, a possible dependence between the nose-to-chin distance and the eye-to-ear distance by sex, age, and facial type was calculated by using multiple regression analysis (α=.05). The data were analyzed by using statistical software (STATA 14.0; StataCorp LLC).

RESULTS

The overall sample was 385 participants between 18 and 50 years of age: 238 women (average ±standard deviation age 32.5 ±7.52 years) and 147 men (32.1 ±7.54 years). Face types were classified as 30.9% leptoprosopic (16.1% women and 14.3% men); 42.9% mesoprosopic (28.8% women and 14.1% men); and 26.7% euryprosopic (16.9% women and 9.8% men).

According to the z-scores for distances measured in this study, 4 participants were discarded from the sample because their measurements lay outside ±3 standard deviations; all other participants were considered valid. Although there were 10 outliers in the final data sample, they were included as they were within the ±3 standard deviations criteria and did not show great differences overall (Fig. 4). Further, these 10 outliers met the inclusion and exclusion criteria. Thus, the final sample for this study was 381 participants; 237 women (32.53 ±7.52 years), 144 men (32.01 ±7.52 years); 30.2% leptoprosopic (16.3% women, 13.9% men); 43.0% mesoprosopic (28.9% women, 14.2% men); 26.8% euryprosopic (17.1% women, 9.7% men). A descriptive analysis for the nose-to-chin distances and right and left eye-to-ear measurements for all face types is shown in Table 1.

For all facial types, the left eye-to-ear distance showed a better correlation with the nose-to-chin

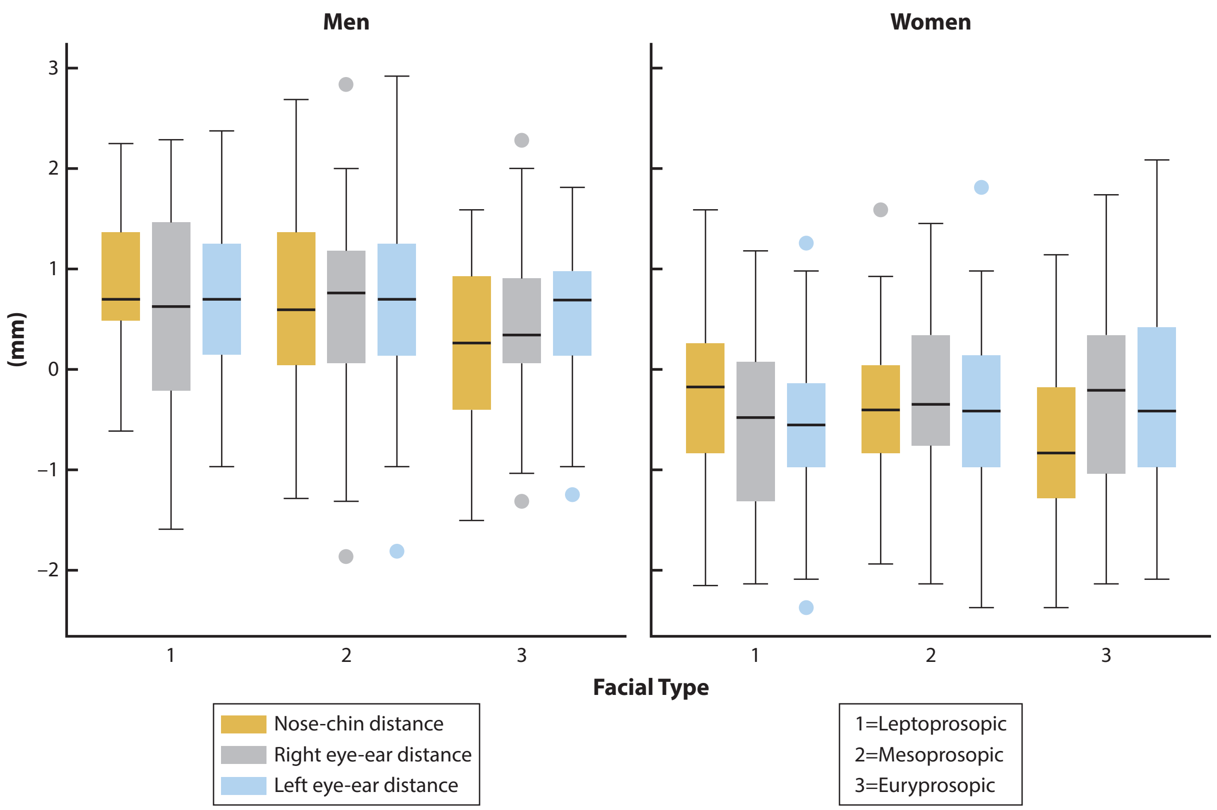

Figure 4. Z-scores for average distances (mm) according to sex and facial type.

Table 1. Descriptive analysis in millimeters for the right and left eye-to-ear and nose-to-chin distances according to facial type

Facial Type	N	Min	p25	p50	p75	Max	Mean	SD
Leptoprosopic								
Nose-to-chin distance	115	61	69	72	75	81	72.14	4.27
Right ear-to-eye distance	115	61	66	68	71	77	68.55	3.58
Left eye-to-ear distance	115	60	66	68	71	77	68.50	3.55
Mesoprosopic								
Nose-to-chin distance	164	62	67	70	73	83	70.49	4.28
Right ear-to-eye distance	164	62	66	69	71	79	68.71	3.38
Left eye-to-ear distance	164	60	66	68	71	79	68.48	3.44
Euryprosopic								
Nose-to-chin distance	102	60	66	70	73	78	69.55	4.30
Right ear-to-eye distance	102	61	66	69	71	80	68.74	3.45
Left eye-to-ear distance	102	61	65	69	71	76	68.37	3.50
Total								
Nose-to-chin distance	381	60	67	70	73	83	70.74	4.39
Right ear-to-eye distance	381	61	66	69	71	79	68.67	3.45
Left eye-to-ear distance	381	60	66	68	71	79	68.45	3.48

Max, maximum; Min, minimum; SD, standard deviation.

distance (leptoprosopic r=0.54, mesoprosopic r=0.60, euryprosopic r=0.55, total sample=0.56) than the right eye-to-ear distance (leptoprosopic r=0.48, mesoprosopic r=0.56, euryprosopic r=0.54, total sample=0.51), with a positive correlation between the variables (Table 2).

Multiple regression analysis revealed that the nose-to-chin distance depended on sex (*P*<.001) and facial type (*P*<.01); age was dismissed as a predictive variable as it was not statistically significant (*P*=.57) (Table 3). Thus, a model was obtained (Table 4) from which the following equation was derived: OVD=42.17+(0.46× left eye-to-ear distance)+sex (women=−3.38, men=0)+ facial type (leptoprosopic=0, mesoprosopic=−1.19, euryprosopic=−2.19).

DISCUSSION

According to the provided results, the research hypothesis of this clinical study was partially accepted. A positive correlation was found between OVD and the left eye-ear distance (r=0.56), and it was dependent on sex (*P*<.001) and facial type (*P*<.01). However, age was not a variable on which the OVD depended (*P*=.57).

The results of this clinical study are consistent with the findings of Chou et al.[12] To predict the nose-to-chin distance, the left eye-to-ear distance should be used by measuring between the anterior wall of the left external auditory meatus and the medial aspect of the lateral wall of the left orbit for all the different facial types (leptoprosopic r=0.54, mesoprosopic r=0.60, euryprosopic r=0.55).

Sex is a factor related with various functional and anatomic aspects. Compared with women, the crania of men are larger and heavier, with more prominent muscle insertions due to greater muscle development, greater

Table 2. Pearson correlation coefficients for the right and left eye-to-ear distances and nose-to-chin distance according to facial type and for total sample

Facial Type	Nose-to-Chin Distance	Right Eye-to-Ear Distance	Left Eye-to-Ear Distance
Leptoprosopic			
Nose-to-chin distance	1.0000		
Right eye-to-ear distance	0.4809	1.0000	
Left eye-to-ear distance	0.5409	0.9389	1.0000
Mesoprosopic			
Nose-to-chin distance	1.0000		
Right eye-to-ear distance	0.5638	1.0000	
Left eye-to-ear distance	0.6053	0.9454	1.0000
Euryprosopic			
Nose-to-chin distance	1.0000		
Right eye-to-ear distance	0.5464	1.0000	
Left eye-to-ear distance	0.5568	0.9372	1.0000
Total sample (n=381)			
Nose-to-chin distance	1.0000		
Right eye-to-ear distance	0.5139	1.0000	
Left eye-to-ear distance	0.5602	0.9405	1.0000

Table 3. Multiple regression coefficients for nose-to-chin distance prediction including all variables

Variables	Coefficient	Std Err	*P*	95% Confidence Interval
Left eye-to-ear distance	0.460	0.0552	<.001	0.3518053 to 0.570172
Women	-3.403	0.4002	<.001	-4.190263 to -2.616123
Age	0.012	0.0221	.577	-0.031226 to 0.056028
Facial type				
Mesoprosopic	-1.202	0.3964	.003	-1.982590 to -0.423405
Euryprosopic	-2.203	0.4405	<.001	-3.070761 to -1.335978
Cons	42.007	3.9199	<.001	34.29953 to 49.71532

Std Err, standard error.

Table 4. Multiple regression coefficients for nose-to-chin distance prediction excluding age variable

Variables	Coefficient	Std Err	*P*	95% Confidence Interval
Left eye-to-ear distance	0.464	0.0551	<.001	0.355707 to 0.572699
Women	-3.385	0.3986	<.001	-4.169577 to -2.601731
Facial type				
Mesoprosopic	-1.197	0.3960	.003	-1.976521 to -0.419194
Euryprosopic	-2.195	0.4405	<.001	-3.061766 to -1.329445
Cons	42.173	3.9051	<.001	34.494470 to 49.8519

Std Err, standard error.

facial heights and facial indices, and anatomic differences in the region of the external auditory meatus.[27] The results were consistent with the work of Chou et al[12] in that the craniometric method differs depending on sex. Therefore, statistically significant differences were expected between sexes ($P<.001$) when the craniometric method of predicting OVD was used.

Regarding facial type, the vertical craniofacial morphology pattern of the patient should be considered ($P<.01$), mainly because of growth vectors and muscular patterns that represent the different facial types.[25] The craniometric method uses the eye-to-ear distance as its predictive distance, relying on measurements recorded from the neurocranium, which, unlike the viscerocranium, undergoes rapid growth during the prenatal period. The latter develops at a later stage and is largely influenced by functional factors such as breathing, phonation, mastication, and muscle development.[28] The results of this study concur with these observations, and this is why facial type must be considered when predicting the nose-to-chin distance.

Another important aspect arising from this clinical study is the fact that the OVD is not affected by age ($P=.57$) despite a participant age range between 18 and 50 years. Older people who may experience tooth wear do not necessarily experience loss of OVD because of compensatory mechanisms, mostly at the expense of the occlusal plane.[29,30]

Therefore, according to the results from this study and the supporting evidence of previous morphometric studies, the variables of sex and facial type must be considered when the left eye-to-ear distance is used as a predictor in restoring the OVD. A maximum eye-to-ear difference of 5.5 mm between the combined variables (leptoprosopic men versus euryprosopic women). According to Abduo and Lyons,[31] 5 mm is the limit for increasing the OVD.

This study proposes a variation of the Knebelman technique for determining the OVD, by using an equation with the left eye-to-ear distance, sex, and facial type and using anatomic calipers. The equation can be solved in different ways, including with a mobile application or a spreadsheet with the formula entered. However, the proposed method relies on soft tissue landmarks, which could introduce errors if too much pressure is applied when measuring distances. This problem has been reported in other studies that have used anatomic landmarks.[7,12,18,19] The proposed technique should be used as a baseline because it is straightforward and requires little time, but it needs to be used together with other methods to completely determine the OVD.

CONCLUSIONS

Based on the findings of this clinical study, the following conclusions were drawn:

1. Occlusal vertical dimension depends on facial type and sex, both of which are craniometric variables.

2. A baseline method was proposed to determine the OVD by using the left eye-to-ear distance as an initial reference and consisting of a straightforward mathematical calculation.

REFERENCES

1. The glossary of prosthodontic terms. Ninth edition. J Prosthet Dent 2017;117(5S):e1-105.
2. Schuyler C. Problems associated with opening the bite which would contraindicate it as a common procedure. J Am Dent Assoc 1939;26:734-40.
3. Monteith B. The role of the free-way space in the generation of muscle pain among denture-wearers. J Oral Rehabil 1984;11:483-98.
4. Gattozzi JG, Nicol BR, Somes GW, Ellinger CW. Variations in mandibular rest positions with and without dentures in place. J Prosthet Dent 1976;36:159-63.
5. Tench R. Dangers in reconstructing involving increase of the vertical dimension of the lower third of the human face. J Am Dent Assoc 1938;25:566-70.
6. Moreno-Hay I, Okeson JP. Does altering the occlusal vertical dimension produce temporomandibular disorders? A literature review. J Oral Rehabil 2015;42:875-82.
7. Niswonger M. The rest position of the mandible and the centric relation. J Am Dent Assoc 1943;21:1572-82.
8. Orenstein NP, Bidra AS, Agar JR, Taylor TD, Uribe F, Litt MD. Changes in lower facial height and facial esthetics with incremental increases in occlusal vertical dimension in dentate subjects. Int J Prosthodont 2015;28:363-70.
9. Silverman MM. The speaking method in measuring vertical dimension. 1952. J Prosthet Dent 2001;85:427-31.
10. Shanahan TE. Physiologic vertical dimension and centric relation. 1956. J Prosthet Dent 2004;91:206-9.
11. Alhajj MN, Khalifa N, Abduo J, Amran AG, Ismail IA. Determination of occlusal vertical dimension for complete dentures patients: an updated review. J Oral Rehabil 2017;44:896-907.
12. Chou TM, Moore DJ, Young L Jr, Glaros AG. A diagnostic craniometrics method for determining occlusal vertical dimension. J Prosthet Dent 1994;71:568-74.
13. Boyanov B. Determining vertical dimension of occlusion and centric relation. J Prosthet Dent 1970;24:18-24.
14. Orthlieb JD, Laurent M, Laplanche O. Cephalometric estimation of vertical dimension of occlusion. J Oral Rehabil 2000;27:802-7.
15. Hull CA, Junghans JA. A cephalometric approach to establishing the facial vertical dimension. J Prosthet Dent 1968;20:37-42.
16. Qamar K, Munir U, Naeem S. Role of cephalometry in evaluation of vertical dimension. Pak Oral Dental J 2013;33:183-6.
17. Edwards CL, Richards MW, Billy EJ, Neilans LC. Using computerized cephalometrics to analyze the vertical dimension of occlusion. Int J Prosthodont 1993;6:371-6.
18. Willis FM. Esthetics of full denture construction. J Am Dent Assoc 1930;17:636-42.
19. Ladda R, Kasat VO, Bhandari AJ. A new technique to determine vertical dimension of occlusion from anthropometric measurements of fingers. Indian J Dent Res 2013;24:316-20.
20. Aboul-Ela LM, Razek MK. Pre-extraction records of the occlusal plane and vertical dimension. J Prosthet Dent 1977;38:490-3.
21. Smith DE. The reliability of pre-extraction records for complete dentures. J Prosthet Dent 1971;25:592-608.
22. Bissasu M. Pre-extraction records for complete denture fabrication: a literature review. J Prosthet Dent 2004;91:55-8.
23. Knebelman S. Method for determining vertical dimension. US patent 4718805 Jan 12, 1988.
24. Delić Z, Simunović-Soskić M, Perinić-Grzić R, Vukovojac S, Rajić Z, Kuna T, et al. Evaluation of craniometrics methods for determination of vertical dimension of occlusion. Coll Antropol 2000;1:31-5.
25. Manns A, Valdivieso C, Rojas V, Valdés C, Ramirez V. Comparison of clinical and electromyographic rest vertical dimensions in dolichofacial and brachyfacial young adults: A cross-sectional study. J Prosthet Dent 2018;120:513-9.
26. Companioni A, Torralbas A, Sánchez C. Relation between the aureal proportion and the facial index in students of Stomatology of La Habana. Rev Cubana Estomatol 2010;47:50-61.
27. Keen JA. A study of the differences between male and female skulls. Am J Phys Anthropol 1950;8:65-80.
28. Sonnesen L, Bakke M. Molar bite force in relation to occlusion, craniofacial dimensions, and head posture in pre-orthodontic children. Eur J Orthod 2005;27:58-63.
29. Berry DC, Poole DF. Attrition: possible mechanisms of compensation. J Oral Rehabil 1976;3:201-6.
30. Johansson A, Johansson AK, Omar R, Carlsson GE. Rehabilitation of the worn dentition. J Oral Rehabil 2008;35:548-66.
31. Abduo J, Lyons K. Clinical considerations for increasing occlusal vertical dimension: a review. Aust Dent J 2012;57:2-10.

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