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Determining a More Reliable and Accurate Method That Dental School Students use to Record Occlusal Vertical Dimension.

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ABSTRACT

The establishment of the vertical maxillo-mandibular relationship is an important phase for the construction of a complete denture. From a practical point of view, it is difficult to reach a definite occlusion. However, there are three techniques commonly used by dental students for the measurement of the vertical dimension of occlusion with accuracy. These are the swallowing, phonetic and esthetic, and the conventional techniques. This study is designed to statistically compare the accuracy of the measurements obtained using these three different techniques. The data of this study consisted of four readings of the occlusal vertical dimension of ten randomly selected patients using all three different techniques. This study concluded that there is no significant difference between the three measuring techniques. This was determined by the lack of any significant statistical differences. A P value of (0.05) was used. Therefore, either one of the three methods can be utilized with equal reliability. Additionally, the study found that the esthetic and phonetic method, which is an easier technique to be used by students, showed more consistency with successive measurements.

Keywords: Reliable, Dental School, Occlusal, Vertical Dimension

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INTRODUCTION

The establishment of a vertical maxillo-mandibular relationship is an essential phase of the complete denture prosthesis. However, it is difficult to reach a definite occlusion from a practical point of view. Traditionally, the vertical jaws' relation has been established by measuring the distance between the two jaws in a vertical dimension under specified conditions. Unfortunately, there is no established body of literature to support the adequacy of using the traditional approach to record the vertical occlusal dimension. Moreover, the vertical relationship between the mandible and the maxilla has been established by two different ways regarding the occlusal stop from the teeth or occlusal rims.

Additionally, there was a new technique published in 2010 that determined the vertical dimension of occlusion from an anthropometric measurement of the interpupillary distance. This was based on the correlation between the vertical dimension of occlusion (VDO) and the interpupillary distance (IPD). However, this technique is not popular and difficult to use by dental students.

Given the facts above, this study is intended to compare the accuracy and reliability of the three techniques commonly used by dental students to measure the vertical dimension with accuracy. This statistical comparison is intended to find the proper technique that has the highest level of accuracy and reliability. The three techniques commonly used by dental students to measure the vertical dimension with accuracy are:

- The Swallowing Technique, where the vertical dimension of occlusion is measured by swallowing.
- The Phonetic and Esthetic Technique, where the vertical dimension of occlusion is measured based on proper phonetic and esthetic.
- The Conventional Technique, where observation is key.

The main clinical challenge in these techniques is finding a proper method to measure the vertical dimension of occlusion with the highest accuracy, which is required in order to overcome all other problems resulting from the high or low vertical dimension of occlusion. Therefore, the main purpose of this study is to evaluate the three methods of measurement of vertical dimension of occlusion which include the vertical dimension of occlusion using swallowing technique, the vertical dimension of occlusion using phonetic and esthetic technique and the vertical dimension of occlusion using the conventional method.

The anticipated advantages of this investigation can be summarized in the following points:

1. The sample of the study is considered adequate (aiming to compare reliability of three different methods of measurement of the vertical dimension of occlusion).
2. Statistical analysis is used to compare the recorded results to indicate the differences at 95% confidence level that gives more reliability to the results.

The hybrid nature of the study design used in this investigation allows for the comparison of results obtained from the three different methods used for measuring the occlusion vertical dimension in this investigation. For the convenient purposes of this study, ten patients were selected randomly. The data was collected by obtaining four readings of the occlusal vertical dimension of each individual patient using the three different measurement methods. This shows that the data has been subjected to a trustworthy statistical analysis, non-parametric test, thus can evaluate the occlusal vertical dimension of these three different methods used in this investigation. This is a true experimental design pretest.

MATERIAL AND METHODS

The data has been obtained from ten patients selected randomly to construct a complete denture using different methods with following records:

- Swallowing technique: four readings of the occlusal vertical dimension were taken using this technique for each individual patient.



- An esthetic and phonetic technique: four readings of the occlusal vertical dimension were also taken using this technique for each individual patient.
- Conventional method: four readings of the occlusal vertical dimension were also taken using this method. The patients were comfortably seated on a dental chair with the head position recorded on Frankfort's plane.

The Frankfort plane is one of the most commonly used planes and will be referred to latter in this investigation. The Frankfort plane is used in craniometry that is determined the highest point on the upper margin of the opening of each external auditory canal and the low point on the lower margin of the left orbit and that is used to orient a human skull or head usually so that the plane is horizontal, it is also called eye-ear plane.

An impression compound was used in the swallowing technique as a bite rim instead of wax, making a V shape on both sides of the posterior part of the bite rim as an index. A double layer of wax as bite rim was used in the lower base. The patient was then seated on a dental chair with his Frankfort Plane parallel to the floor. Two marked points in the same vertical line were taken with one point in the upper lip and another point in the lower lip.

The upper bite rim was inserted in the patient's mouth, then a soft wax was fixed on the lower bite rim. It was found that using an adhesive to the tissue surface of the upper and lower base plate is better than other relations as it had more accurate results. The patient was then asked to insert the lower bite rim and swallow. Following this step, the patient was asked to stop the action in order to measure the distance between the two points and record the readings. The procedure was repeated four times for each individual patient in the study sample.

- Conventional method: For this method was conducted by asking the patients to count from one to ten and then close their mouth at rest and the same physiological position without inserting the upper and lower bite rim. Then the students measured the distance between the two points as it was done in the swallowing technique.

The readings were then recorded, and the procedure was repeated four times for each individual patient in the study sample.

- The aesthetic and phonetic technique: In this technique, a fixed small double layer of wax was taken of a smaller size than the upper six anterior teeth (anterior to the incisive papilla). The purpose of this wax is to look for the esthetic and phonetic proper location of the six upper anterior teeth (natural zone), midline, high lip line, low lip line, smiling line, and lip support. The upper base plate was inserted and modified.

The sheet of wax was then fixed according to the factors mentioned previously and specially check for phonetic tone by asking the patients to say an (f) sound in the words like (fiel or felise) and we noticed that the lower edge of wax was slightly touched by the upper lingual surface of the lower lip. The (S) sound was also checked in words like (madrasa , filise ,sem sen) then the patients were asked to count from 60-69 . It was noticed that the patient pronounced these words properly. The sheet of wax was in the right position if the pronunciation was correct. However, when the pronunciation was not proper (s sounded like ash), the wax sheet was adapted until a proper sound of S was obtained.

The six upper anterior teeth were in the wax sheet position for esthetic examination, the midline, high lip line, low lip line, smiling appearance, canine position and upper lip support were all checked for proper position.

After completing the set-up of the six upper anterior teeth, a double –layer of wax was placed in the crest of the anterior part of lower base plate.

The layer size was smaller than the one for the lower six anterior teeth. The lower base plate was then inserted into the patients' mouth. The patient was then asked to count from one to ten with a continuous

observation of the movement of the upper anterior teeth and the lower double layer of wax. The adhesive in-tissue surface of the upper and lower base plate was used to increase the retention for accurate results. After obtaining the correction between the position of the lower wax according to the over-bite, over jet, esthetic and phonetic position, the six lower anterior teeth were set up in the wax sheet position to check again for the over bite and over jet following the posterior built up. The shape of a V in both sides of the upper bite rims was considered as an index.

The double layer of wax was placed in the posterior part of the lower base plate slightly higher than the normal lower posterior bite rim for inserting the upper bite rim in the patient mouth. After softening the wax in the posterior part of the lower base, the lower base plate was then inserted. The patients were then asked to close their mouth under the dentist control in order to get the same overbite and overjet to measure the distance between the two points for the recording of the readings.

The same procedure was repeated four times for each individual patient in the study sample.

RESULTS AND DISCUSSION

The data tabulated in table no. (1) is composed of two factors:

1. The first one is called "The classes" which represents the measurement method of the front perpendicular elevation obtained by the following techniques: conventional, swallowing and phonetic and esthetic respectively.
2. The second one is called "The pillars" which represents the patient's S factor of the individual research sample to ensure the readings of each parameter of the table with the assumption of the interaction of two factors with each other along with the employment of the "two-way analysis of variance with interaction fixed effects model " in order to examine the following statistical hypotheses:

1. Hypothetical test corresponding to the measurement methods of equal distance mean specific of the perpendicular elevation of the front, in addition to the presence of another hypothesis of variation between the two methods as show in table (2) and the null-hypothesis (H₀) which says that:

A=1,2,3, of all values

$$H_0: \mu_i = 0$$

And the alternative hypothesis H₁ which says:

H₁: (all μ_i values are not zeros).

According to the level of significance (0.05), the critical point which is obtained by the graphics integration of table (f) is:

$$F(0.95, 2, 90) = 3.011$$

Since F value is calculated from ANOVA (variance analysis table) and is equal to 3.863 and larger than (3.11). Therefore, H₀ is assumed to be unaccepted, concluding that there is a significant difference between the two-measurement methods. In other ward, the measurement methods are at least not symmetrical to each other giving the differences in their technical means.

Multiple scheff S test was used to indicated the measurement techniques and their effect on the distance means of the front perpendicular elevation in order to test the following hypotheses:

$$H_0: 1-2=0$$

$$1-3=0$$

$$2-3=0$$

On a level of significance (0.05), the value (S_r²) is equal to 6.22.

Since the calculation value of F is equal to (7.113) which is larger than (6.22) according to the special relation of the test, therefore, $1-2=0$ is refused and unaccepted considering there is a difference between the first and the second techniques.

The application of Tukey and Bon Ferroni tests showed that the perpendicular elevation was less significant than the second technique. The rest of the means comparing between the first and third or between second and third were equal to each other.

2. Similarly, the measurements of different sample individualities of research are tested through the symmetry of the individual variances of patient by taking the symmetric of distance measurements averages of specification number of readings of each case compatible of the measurement methods followed in corresponding of the existence of differences hypotheses between two individual samples at least.* the hypothesis has been as follows:

*no. of possible different cases, 10 combinations taken in each case no. of cases of different $10^2=100$ case.

$H_0: B_J(**) = 0. \quad J=1,2,3, \dots, 10$

$H_1: (\text{considering all } B_J \text{ are not zero}).$

Table NO. (1): The observed value for all data of the sampling study(patients)

patients methods	A	B	C	D	E	F	G	H	I	J
Conventional technique	3.36	4.22	2.98	3.30	4.18	3.93	3.84	3.30	4.60	3.74
	3.44	4.32	3.06	3.38	4.36	3.98	3.89	3.23	4.54	3.56
	3.43	4.40	2.93	3.48	4.26	3.96	3.74	3.20	4.70	3.62
	3.50	4.60	2.90	3.50	4.33	4.00	3.90	3.14	4.51	3.70
Swallowing technique	3.30	4.22	2.80	3.80	4.58	3.80	4.00	3.58	4.60	3.72
	3.10	4.52	2.79	3.70	4.55	4.00	3.86	3.50	4.30	3.90
	3.17	4.96	2.70	3.90	4.63	4.01	4.06	3.40	4.48	3.80
	3.42	4.00	2.68	3.86	4.60	3.93	3.95	3.30	4.48	3.63
Phonetic and esthetic technique	3.33	4.10	2.09	3.66	4.00	4.05	3.95	3.22	4.40	3.98
	3.32	4.09	3.00	3.61	4.48	4.00	4.00	3.20	4.42	4.00
	3.31	4.05	3.12	3.63	4.42	4.30	4.00	3.26	4.46	4.00
	3.30	4.04	3.10	3.60	4.48	4.20	4.00	3.25	4.40	4.00

Table no. (2) : the average of the observed value for the three techniques of all sampling data.

Patients Mean of methods	A	B	C	D	E	F	G	H	I	J	Y1..
Y1	Y1 1. 34.352	Y1 2. 43.850	Y1 3. 29.675	Y1 4. 34.250	Y1 5. 42.825	Y1 6. 39.675	Y1 7. 58.425	Y1 8. 32.175	Y1 9. 45.900	Y1 10. 36.550	Y1.. 37.755
Y2	Y2 1. 32.475	Y2 2. 44.250	Y2 3. 27.425	Y2 4. 58.150	Y2 5. 45.900	Y2 6. 59.350	Y2 7. 39.675	Y2 8. 34.450	Y2 9. 44.650	Y2 10. 37.625	Y2.. 38.395
Y3	Y3 1. 33.150	Y3 2. 40.700	Y3 3. 50.775	Y3 4. 36.250	Y3 5. 44.550	Y3 6. 40.250	Y3 7. 39.875	Y3 8. 52.326	Y3 9. 44.105	Y3 10. 39.950	Y3.. 3.81975
Y.j.	Y.1. 33.316	Y.2. 42.933	Y.3. 29.2916 6	Y.4. 36.183	Y.5. 44.425	Y.6. 39.758	Y.7. 39.325	Y.8. 32.983	Y.9. 44.9	Y.10. 38.041	Y. .. 3.81786

On level significance (0.05), the critical point from table (f) is:
 $F(0.95, 9.90) = 2$

Since (f) value is calculated to be (283.603) which is larger than the critical point value, therefore, H_0 is refused. It has been concluded that there is a great meaningful difference resulting from the difference of individualities of the sample by each other. This result invites one to consider the research reliability using several and unlimited individualities rather than one.

3. A test for the existence of the interaction between the influence of the types of perpendicular-elevation measurement methods and the individualities of the research sample to establish the existence of this relationship, the following hypotheses was examined:

$H_0: (B)_{ij} = 0 \quad i=1,2,3 \dots$

$J=1,2,3, \dots, 10$

$H_1 = :$ (considering all $(B)_{ij}$ are not zero)

On level of significance (0.05), the critical point from table (f) obtained by the demographic integration is:

$F(0.95;13,90)=17.41$.

* B_j of patient's pillar factor

Since f value calculated to be equal to (7.413) which is larger than its corresponding value in the table, therefore H_0 is unacceptable and refused.

Table no. (3): The Variance of the Average Readings

(3) 2_i	N_i
28.441	10
33.765	10
23.444	10

CONCLUSIONS

The study concluded that there is no interaction between the influence of the three types of measurement methods and the individualities of the research sample. The preference of a certain technique over another is chosen according to both technique properties and the difference of persons studied through the examination results of the second hypothesis which reflects the case of the presence of great difference between the individualities of research sample (patients).

It is quite clear that the variance of the average readings of table (3) for all patients according to the third technique is equal to 23.444, which is less than the variances of the first and the second techniques, which are equal to (28.441) and (33.765) respectively.



It is obvious that the measurements observed for all patients in the second technique are more dispersed than the others.

The employment of the Bartlet test for the examination of the hypotheses of equal variance of reliable measurement

"B" value for Bartlet test obtained from the significance:

$$B = \frac{(n-r)1n(1/n-1(ni-1)si-(ni-1)insi)}{1+1/3(r-1) (1/ni-1 - 1/(n-r))}$$

Methods corresponding to the presence of variance between at least two techniques, has led to the examination of the Null-hypothesis (H0) of the statement:

$$H_0 = \sigma_1^2 = \sigma_2^2 = \sigma_3^2$$

Corresponds to the alternative hypothesis that two variances are not equal at last.

On the level of the significant (0.05), (chi-square) is:

$$\chi_{0.95;2} = 5.99.$$

Since the significance of the calculated B value of the mentioned examination is equal to (0.284), which is considered less than its corresponding table value, therefore H0 is acceptable. It has been concluded that the variances of the measurement methods are equal according to the reliable significance level of the analysis found in the investigation, and therefore the three methods can be used to record occlusal vertical dimension without statistical differences.

It is also found that the esthetic and phonetic method is just as sufficiently reliable compared to other methods. This is because the four reading of the occlusal vertical dimension show less variance than when other methods were used in this investigation.

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