ORIGINAL ARTICLE

Evaluation for the Reliability of the Craniofacial Measurements in Determination of Vertical Dimension of Occlusion

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ABSTRACT

Purpose: This study was aimed to investigate the reliability of the craniofacial measurements in determination of the vertical dimension of occlusion (VDO). **Methods and Subjects:** A total of 65 subjects (Group I) and 15 edentulous patients (Group II) were selected. For Group I, the chin–nose, corner–another corner of the lips, the outer canthus of the eye–inner canthus of another eye, and the ear–eye distances were measured using a modified caliper when the patient closed in centric occlusion. For Group II, the VDO was determined for each subject using the rest position method in the usual manner, while the record blocks were in patient mouth the chin-nose distance and outer canthus of one eye - inner canthus of another eye distance were measured and recorded. **Results:** The results of Group I revealed that there was no significant difference between the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance ($P \geq 0.05$) and also revealed a high correlation between them. There was no significant difference between the clinically measured chin–nose distance and calculated chin–nose distance of Group II ($P \geq 0.05$), and also there was a high correlation between them. **Conclusion:** The use of the outer canthus of the eye–inner canthus of another eye distance to predict chin–nose distance with reasonable accuracy with the caliper method was recommended as a reliable method in determination of the VDO.

Key words: Anthropometric measurements, craniofacial measurements, VDO, vertical dimension of Occlusion

INTRODUCTION

The establishment of a correct vertical dimension of occlusion (VDO) is the most critical procedure in clinical dentistry. The dentists play an important role in restoring VDO in completely edentulous patients. Violation or alteration (increase or decrease) of the VDO can affect esthetics of soft facial tissues and induce speech difficulties, temporomandibular joint troubles, craniomandibular disorders, muscle discomfort, and headache. The craniomandibular disorders can affect the chewing, swallowing, and breathing. Correcting these disorders can bring truly marvelous improvements in the general health and well-being of the patients. Hence, incorrect determination of the VDO may result in failure of complete denture treatment.[1-3]

Many methods had been advocated by many authors to establish the VDO in completely edentulous patients. These methods are the use of pre-extraction records and measurements, ridge parallelism, physiologic rest position, the swallowing phenomenon, phonetics, and esthetics. Recently, the cephalometric X-ray and quadrilateral analysis had been used for establishment of the VDO in completely edentulous patients.[4-13]

Where growth, development, and occlusion of the skull are normal, it is possible to correlate the distances of craniofacial

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landmarks and record a measurement from the skull that may be used to help establish VDO.[14]

Many authors had used the facial measurements to predict the VDO.[15-17] The ear-eye and chin-nose distances were measured with a modified craniometer. The results revealed that left ear-eye distance can be used to predict chin-nose distance with reasonable accuracy.[18]

Geerts *et al*.[20] compared the accuracy of two methods (the Willis gauge method with the caliper method) used by pre-doctoral students to measure the vertical dimension. They found that the use of the caliper method by pre-doctoral students was a significantly more reliable method of measuring the VDO for the patients evaluated.

Another study had been carried out, but in large scale, the results of this study showed that the base of chin–subnasale measurements was correlated to the Willis measurement more than to other anthropometric measurements.

The dentists meet difficulty to select the best method of craniofacial measurements that help in restoring or determination of the VDO. This study was aimed to investigate the reliability of the craniofacial measurements (chin–nose, corner–another corner of the lips, the outer canthus of the eye–inner canthus of another eye, and the ear–eye distances) in determination of the VDO.

METHODOLOGY

Eighty subjects were selected and divided into two groups. For Group I, 65 males, completely edentulous (ages 20–23 years), angle Class I with good general health condition were selected. For Group II, 15 males, completely edentulous (ages 51–62), skeletal Class I with good general health condition were selected.

The Following Measurements were carried out for Each Subject of Group I

The chin–nose, corner–another corner of the lips, outer canthus of one eye–inner canthus of another eye, and the eye–ear measurements were measured using a modified caliper when the patient closed in centric occlusion.

- The chin–nose measurement (M1): The distance between the undersurface of the chin and the anterior nasal spine area with firm pressure (when the maxillary jaw was occluded) was measured and recorded at the midline of the face.
- Corner–another corner of the lip measurement (M2): The distance between corner of the lips and another corner of the lips following the curvature of the mouth was measured and recorded.
- Outer canthus of one eye–inner canthus of another eye measurement (M3): The distance between the outer canthus of one eye and inner canthus of another eye was measured and recorded.
- The eye–ear measurement (M4): The mesial wall of the external auditory canal and the lateral border of the ocular orbit were marked by an indelible pencil, and then, the tips of the modified caliper were placed into the two marks while the caliper was positioned perpendicularly to the sagittal plane of the skull. The head was adjusted in an upright unsupported position with the bubble in the middle of the spirit level.[14,17]

The Following Steps and Measurements were carried out for Each Patient of Group II

The VDO was determined using the rest position method in the usual manner, while the record blocks were in patient mouth the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance were measured and recorded [Figures 1 and 2]. Then, the conventional steps of complete denture construction were carried out.

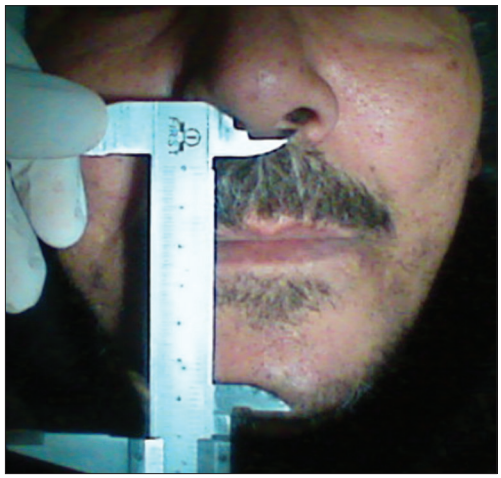

Figure 1: Chin–nose distance

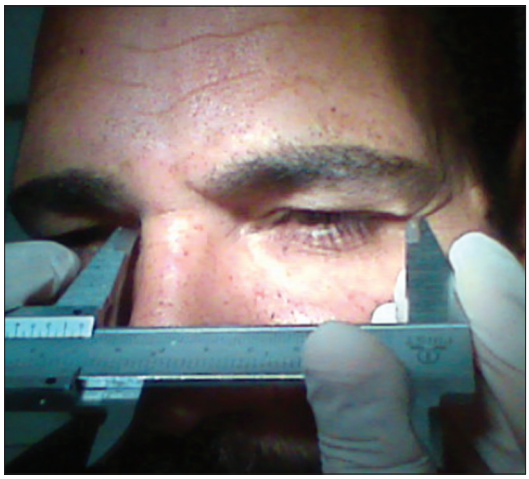

Figure 2: Outer canthus of the eye–inner canthus of another eye distance

The statistical analysis for Group I was carried out by using Paired *t*-test, the Pearson's correlation, and regression analysis. However in group II the statistical analysis was done by using the Paired t test, also the Pearson's correlation was used to analyze the clinically measured nose–chin distances and calculated nose–chin distances (using regression line equation).

RESULTS

The results of this study revealed that there were significant differences between the chin–nose distance and corner–another corner of the lip distance, and the chin–nose distance and the eye–ear distance ($P < 0.05$). However, there was no significant difference between the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance ($P \geq 0.05$). Furthermore, the results showed that there was a high correlation between the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance [Table 1]. Regression analysis of the results of the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance of Group I was carried out to obtain the regression linear equation. From the regression analysis, the distances of chin–nose could be determined through the following equation: $M1=0.96 \times 3 + 0.261$

The previous regression line equation was used in an edentulous group (Group II) to calculate and predict the possible nose–chin distances to compare it with clinically measured chin–nose distances. There was no significant difference between the clinically measured chin–nose distance and calculated chin–nose distance of Group II ($P \geq 0.05$), and also there was a high correlation between them [Table 2].

DISCUSSION

Prosthodontists and dentists are continually confronted with problems related to the determination of the vertical dimension. Even though many methods have been used, it has always been difficult to decide what should be the correct vertical dimension.[3]

An attempt to investigate the reliability of craniofacial measurements in determination of the VDO on dentulous subjects and completely edentulous patients was carried out to determine the most reliable method of craniofacial measurements that may be used in determination of the VDO.

The results of this study revealed that there was no significant difference between the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance ($P \geq 0.05$), and also, there was a high correlation between the chin–nose distance and outer canthus of one eye–inner canthus of another eye distance (R = 0.913).

There was no significant difference between the clinically measured chin–nose distance and calculated chin–nose distance in edentulous patients ($P \geq 0.05$), and also, there was

Table 1: Mean and standard deviation of chin–nose distance and corner–another corner of the lips, the outer canthus of the eye–inner canthus of another eye, and the ear–eye distances of Group I, and paired sample *t*-test and the correlations between chin–nose distance and each one

Variable	Mean±standard deviation	Paired differences			*t*	Significance (two-tailed)	Correlation			
M1	**6.6450±0.4454**	**Mean**	**Standard deviation**	**Standard error mean**						
M2	**5.6250±0.2049**						**Correlation**	**Significant**	**R**	**F**
M3	**6.6500±0.4236**									
M4	**7.6250±0.3552**									
M1–M2		1.020	0.489	0.109	9.319	0.000	0.004	0.986	0.91	90.708
M1–M3		−0.050	0.338	0.040	−0.123	0.904	0.913	0.000		
M1–M4		−0.980	0.507	0.114	−8.637	0.000	0.212	0.369		

Table 2: The mean and standard deviation of the clinically measured nose–chin and calculated nose–chin distances of Group II and paired sample *t*-test and the correlation between them

Variable	Mean±standard deviation	Standard error mean	Paired differences			*t*	Significance	Correlation
Clinical chin–nose	**6.2273±0.5236**	**0.1579**	**Mean**	**Standard deviation**	**Standard error**			
Calculated chin–nose	**6.3177±0.4978**	**0.1501**						
Clinical versus calculated chin–nose distance			−0.090	0.1648	0.049	−1.820	0.099	0.949

a high correlation between the clinically measured chin–nose distance and calculated chin–nose distance in edentulous patients (R = 0.949).

The results of this study are in accord with McGee[15] and Misch16 and at variance with that of Knebelman.[14]

By application of simple equation as a guide during clinical establishing of the VDO for edentulous patients, the optimum VDO can be obtained with consequent favorable function outcome including speech, chewing ability, as well as improvement of patients' esthetics.[19]

In the past, there was no scientific method for determining the correct occlusal vertical dimension. Dentists used trial and error techniques and guesswork to approximate this vital measurement,[20] but now with the results of this study, the use of the outer canthus of one eye–inner canthus of another eye distance was recommended as a reliable method in determination of the VDO through the regression linear equation.

CONCLUSION

Within limitations of this study, it could be concluded that the use of the outer canthus of the eye–inner canthus of another eye distance to predict chin–nose distance with reasonable accuracy with the caliper method was recommended as a reliable method in determination of the VDO.

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