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Relevance of vertical dimension of occlusion with anthropological measures of face and fingers. A cross-sectional study amongst Libyan population

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Abstract: Restoring physiological vertical dimension of occlusion (VDO) is a critical step during complete mouth rehabilitation. An improper VDO compromises the aesthetics, phonetics and functional efficiency of a prosthesis. Universally, there are no precise and consistent methods to record VDO. Many facial and body landmarks have been proposed in the literatures correlating to the VDO, many dentists face difficulties in determining correct VDO due to the subjectivity involved in decision- making, especially when rehabilitating fully edentulous patients or patients who no longer have stable tooth contact. These methods do not require a great amount of time and experience to master. Aim: Investigate the relation between anthropological measurements of face and fingers with VDO. Material and method: A total of 117 subjects of either sex within age group (18 to 60 years) participated in this study, all participants have Class I occlusion with no history of orthodontic treatment. Exclusion criteria included: supra eruptions, physiologic or pathologic migrations, deep bite, open bite, severe attrition, and extensive extra-coronal restorations, such as crowns and bridge work. Facial and hand deformities and subjects with a history of oral and maxillofacial trauma were also excluded because the study involves facial and finger measurements. All the participants in this research were informed about the study and the nature of measurements that would be taken. Ethical statement: this work was carried out under the approval of the institutional ethical committee at University of Benghazi, Libya (approval no.0153). Conclusion: Facial measurements can be used initially to approximate the measurements of VDO and then using the other methods to test the suitability of the dimensions, initially established VDO could be correlated to the

index finger and little finger measurements in Libyan females and could be correlated to measurements of inner canthus of left eye to left corner of mouth (Rima Oris) in both males and females.

Keywords: *Anthropological, Index finger, Little finger, Vertical dimension of occlusion, inner canthous, rima-oris, corner of mouth*

I. Introduction

Restoring physiological vertical dimension of occlusion VDO is a critical step during complete mouth rehabilitation. The generalization of correlation between the facial measurements to VDO is disapproved due to racial differences and it is practical to correlate lower third of the face to the remaining craniofacial measurements in different ethnic groups. Anthropometric measurements are stable landmarks and do not change over the natural aging cycle. These readings are specific to the patient and are easily repeated[1]. Several methods were used in determination of the correct occlusal vertical dimension like anterior teeth measurements, closest speaking space, swallowing method, patient's neuromuscular perception, cephalometric radiographs, intraoral and extra-oral anatomic landmarks[2]. Multiple researchers have attempted to find the correlation between VDO and other craniofacial measurements in various ethnic groups. Since there is a noticeable genotypic and phenotypic variation between ethnic groups, it is sensible to analyze the hypothesis in the different ethnic groups[3]. There is no precise and consistent method to record VDO. Many facial and body landmarks have been proposed in the literatures correlating to the VDO, many dentists face difficulties in determining correct VDO due to subjectivity involved in decision making, especially when rehabilitating fully edentulous patients or patients who no longer have stable tooth contact. An anthropometric method to determine VDO is attractive and practical because it is simple, economic, non-invasive, and reliable[4,5]. Anthropometric measurements like finger lengths and other facial measurements can offer significant prosthetic advantages in estimating the VDO by eliminating the guesswork involved in subjective methods to determine

VDO such as resting jaw position or swallowing method. They do not require radiographs nor special or complicated measuring devices and provide reproducible values for future reference. These methods do not require a great amount of time and experience to master[4,5].

II. Aim:

To investigate the relation between anthropological measurements in the face and fingers with VDO.

III. Material and method:

A total of 117 subjects (58 male and 59 female) within an age group of (18 to 60 years) participated in this study, all participants have Class I occlusion with no history of orthodontic treatment. Exclusion criteria include: supra eruptions, physiologic or pathologic migrations, deep bite, open bite, severe attrition, and extensive extra-coronal restorations, such as crowns and bridge work. Facial and hand deformities and subjects with history of oral and maxillofacial trauma were also excluded because this study involves facial and finger measuring. All the participants in the research were informed about the study and the nature of measurements that would be taken. The following anthropological readings from the face and hands were selected:

1.Base of the nose to inferior of the chin reading was considered as vertical dimension of occlusion (VDO) reading (fig.1).

2. Inner Canthus of the left eye to left Corner of Mouth (Rima Oris) (ICCM) reading (fig.2).

3. Inner Canthus of right eye to Outer Canthus of left eye reading (ICOC) (fig 3).

4. Right Index finger (IF) (fig.4).

5. Right Little Finger (LF) (fig.5).

6. Length of the Right Ear auricle was recorded from upper border of ear to lower border of the pinna of the ear (EL) (fig. 6).

Digital Vernier caliper was placed with the lower end touching the lower border of mandible in chin area at mid-symphysis region with the teeth in maximum intercuspation, the upper end lightly touched the skin at the base of the nose, this was considered as VDO reading. Other facial measurements, such as inner canthus of the right eye to outer

canthus of the left eye and inner canthus of the left eye to rima oris were taken in similar manner, length of the right ear was recorded from upper border of ear to lower border of the pinna of the ear. Patient was asked to keep the right hand in a supine/palmer position, caliper readings were taken from the tip of the finger to the nearest finger crease. An average of 3 readings were taken in all the measurements. The data obtained was statistically analyzed and tabled[6].

Fig.1:VDO

Fig.2:ICCM

Fig.3:ICOC

Fig.4:IF

Fig.5:LF

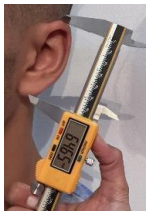

Fig.6:RE

Results:

A screening process was conducted on a sample of 117 individuals, consisting of females 59 (50.4%) and 58 (49.6%) males. The age range of the participants spanned from 18 to 60 years. Table 1 displays the distribution of the Individuals involved in the study, categorized by gender and age group.

Table (1): The distribution of participants by age group and gender.

Age group	Male	Female	Total
18-27 years	23(38.3%)	37(61.7%)	60(51.3%)
28-37 years	14(58.3%)	10(41.7%)	24(20.5%)
>38	21(63.6%)	12(36.4%)	33(28.2%)
Mean age	34±١٢.4	28.37±8.4	31.٢±١٠.9

A study employed an independent-samples t-test to examine the disparities in readings across various parameters for male and female participants. Table (2) presents the relevant data. A statistically significant difference was seen in all parameters, with a p-value of < 0.001 except for Right Inner Canthus of eye to Left Outer Canthus of eye ($p = 0.048$). The findings of this study indicate that there is a notable impact of gender on the VDO measurements. The VDO levels of male subjects were found to be greater in comparison to those of female subjects.

The mean VDO dimension measurements in males was found to be 66.2 mm, with a standard deviation of 5.6 mm. The mean value of (VDO) measurements in females was found to be 60.07 mm, with a standard deviation of 3.8 mm. The t-test conducted to assess equality between measures of (VDO) for males and females yielded a statistically significant difference ($t = 6.804$, $p < 0.001$). A comparative analysis of male and female observations revealed a statistically significant distinction at a significance level of 5%. This finding suggests that males exhibited considerably higher values across all observed readings in comparison to females.

Table(2): Comparison of males and females with mean score of different parameters

Parameter	Male		Female		t value	P value
	Mean	SD	Mean	SD		
Vertical Dimension of Occlusion	66.2	5.6	60.07	3.8	6.804	<0.001
Right Index Finger	71.39	5.46	66.1358	4.62	5.6	<0.001
Right Little finger	60.61	4.82	55.64	4.9	5.5	<0.001
Left Inner Canthus of eye to Corner of Mouth	69.1	5.13	61.9	3.67	8.705	<0.001
Right Inner Canthus of eye To Left Outer Canthus of eye.	60.49	13.5	54.89	16.4	2.002	0.048
Right ear length	62.37	4.08	58.65	6.17	3.793	<0.001

A Pearson correlation coefficient was utilized to examine the association between VDO reading and other anthropological readings (Table 3). The results indicated a medium positive correlation, with "r" values ranging from 0.324 to 0.613, and a p-value of <0.001 for both male and female subjects. Among males, the measurements of the Left Inner Canthus of eye to Corner of Mouth showed a particularly close relationship with VDO dimension readings ($r = 0.380$, $p = 0.004$) compared to other anthropological parameters examined in the study. In females, also the measurements of the Left Inner Canthus of eye to Corner of Mouth were closely associated with VDO dimension readings ($r = 0.512$, $p \leq 0.001$).

Table (3): Correlations between bases of nose-lower border of chin (VDO) with other parameters

Parameter	Vertical Dimension of Occlusion correlation					
	Total n(117)		Male n(58)		Female n(59)	
	r value	P value	r value	P value	r value	P value
Right Index Finger	0.429*	<0.001	0.229	0.087	0.259*	0.047
Right Little finger	0.404*	<0.001	0.191	0.155	0.265*	0.042
Left Inner Canthus of eye to Corner of Mouth	0.613*	<0.001	0.380*	0.004	0.512*	<0.001
Right Inner Canthus of eye To Left Outer Canthus of eye	1	0.284	-0.188	0.162	0.226	0.085
Right ear length	0.324*	<0.001	0.186	0.171	0.202	0.125

* .Correlation is significant at the 0.01 level (2-tailed).

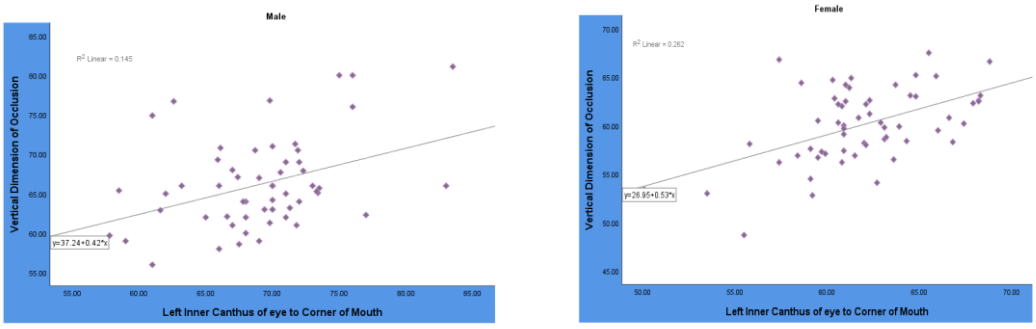

Fig.7: Scatter plot diagram showing the correlations between VDO and Left Inner Canthus of eye to Corner of Mouth in male and female subjects.

IV. Discussion:

Correct vertical dimension of occlusion VDO is important in the construction of complete dentures, as the patients are fully edentulous or no longer have stable tooth contact. Pre-extraction records play a major role in the assessing and establishing VDO. Anthropometric measurements are stable repeatable landmarks and specific to the patient[2]. Incorrect VDO can result in an unsuccessful denture. Where increased VDO can result in difficulty in mastication and speech. It can also lead to muscle spasm and temporomandibular joint disorders[7–9]. Similarly, a decreased VDO can cause early wrinkles, poor chewing, deepening of nasolabial groove and folds at the corner of the mouth that result in collection of saliva and hence angular cheilitis. When pre-extraction records are not available, there is no universally accepted

method for determining VDO. Therefore, several methods have been used for recording the VDO and each method has its limitations to be absolutely accurate. Physiological methods such as swallowing, rest vertical position, phonetics have been used to record VDO. Mechanical methods such as ridge parallelism, pre-extraction records and cephalometric radiographs were also used[10–13]. The difficulty in taking facial measurements is the excessive soft tissue bulk under the chin. The vertical dimension of occlusion must be determined carefully by the dentist for a successful prosthesis VDO is the result of a musculoskeletal balance. The correct VDO can be better described as a range instead of a fixed point. Therefore, to evaluate the VDO, a varied method should be adopted at all the stages of rehabilitation to maximize the benefits and minimize damage to the stomatognathic system[14].This study was made amongst Libyan population in Benghazi city to determine the correlation between VDO and anthropometric craniofacial measurements to be used in the absence of pre-extraction records in male and female subjects to predict VDO before application of more confirming methods. The difference in correlation between male and female craniofacial measurements are due to the more prognathic mandibles and steeper mandibular angle in male in comparison to females, although the anterior lower face height is similar for both genders [15,16]. In our study both genders in the age range of (18_60 years) were involved in determining the correlation between VDO and anthropometric measures (facial and fingers). The left facial measurements were more reliable in predicting OVD than right side measurements. The variation could be due to right hemisphere dominance for emotional expressions. The mobility of facial expression also exhibits facial asymmetry, and studies indicated the left side of the face is most commonly dominant in both males and females[17]. The statistically significant correlation was observed between OVD and the dimension between pupils to the chelion in both genders, similar strong correlations observed between the OVD and the pupil-rima oris distance[18]. The measures used in our study amongst the Libyan population included mainly the right side as measures used from inner canthus of the right eye to outer canthus of left eye, and from inner canthus of left eye to left corner of mouth (rima oris). The right ear auricles length was used. Among males and females, the measurements of the Left Inner Canthus of eye to Corner of Mouth showed a particularly close relationship with VDO compared to other anthropological parameters examined in the study.

It was reported that known VDO of 95% of subjects with natural teeth corresponded with three facial measurements which are: the distance from the center of the pupil of the eye to a line projected laterally from the median line of the lips; the distance from the glabella to the subnasion; and the distance between the angles of the mouth with the lips in repose[19]. Anthropometric measurements of VDO amongst the Arab Saudi population were significantly and positively correlated with length of index finger, length of little finger, and distance from tip of thumb to tip of index finger of the

right hand. In males, correlation of VDO was strongest for the length of the index finger, whereas in females, it was strongest for the length of the little finger[14]. A correlation between VDO and index finger was studied in 250 subjects (166 female and 84 male), significant correlation was revealed between VDO and index finger in both male and female subjects[20]. In this study a correlation was evaluated between VDO which was measured from Base of the nose to inferior of the chin and finger measurements, statistical analysis revealed that VDO was correlated positively with the index finger length and the little finger length in females but in males there was no correlation .

In the VDO measurement taken from the base of the nose to lower border of chin was least correlated to outer canthus of eye to the rima oris measurement. When the VDO measurements were taken from the tip of the nose to the base of the chin, there was strong correlation between the VDO measurement and the outer canthus of eye to the rima oris measurement[21]. Some studies proposed a correlation between the eye – ear distance, but recently it was reported that there is a non -significant correlation between the clinical OVD and eye-ear distances in males[22]. In our study the measurements of VDO was made between base of the nose and the inferior of the chin but the correlation with eye-ear distance was not evaluated, on another hand , right ear auricles lengths were evaluated and no correlation was reported .

Conclusion:

Facial measurements can be used initially to approximate the measurements of VDO and then using the other methods to test the suitability of the dimensions initially established.VDO could be correlated to the index finger and the little finger measurements in Libyan females and could be correlated to the measurements of inner canthus of left eye to left corner of mouth (rima oris) in both males and females .

Ethical statement: this work was carried out under the approval of institutional ethical committee in university of Benghazi, Libya (approval no.0153).

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