

Relationship of Anthropometric Measurements of Interpupillary Distance and Length of Ear with Vertical Dimension of Dental Occlusion - An Anthropometric Study

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Abstract: Introduction: The aim of this study is to find out the relationship of anthropometric measurements of interpupillary distance and length of ear with vertical dimension of dental occlusion, so as to use this correlation to determine vertical dimension of dental occlusion in edentulous patients. Materials and methods: The study is conducted on 210 dentate subjects (105 males and 105 females) who fulfilled the inclusion criteria. Anthropometric measurements of VDO, length of ear, interpupillary distance is recorded using a digital vernier calliper. Relationship between VDO, length of ear and interpupillary distance is studied using Pearson's correlation test. Results: a) Statistical analysis in male and female subjects showed that VDO is significantly different with the length of ear, and interpupillary distance. b) Pearson correlation test showed VDO in males has strong coefficient correlation with the length of the ear, $r = 0.341$ (moderate positive correlation) In females VDO has strong correlation with interpupillary distance, $r = 0.426$ (moderate positive correlation). Conclusion: This study clearly showed that the length of ear in males and the interpupillary distance in females can be used as a measurement to determine VDO in edentulous patients. The mentioned regression model can also be used to determine VDO in edentulous patients with the help of length of ear, interpupillary distance. Clinical significance: The landmarks used in the present study can be used more reliably since the dimensions of these will not change for the rest of the life of the individual, unless traumatized or pathologically involved. Parameters are easily accessible to the clinician and are static so that the time taken for estimating the exact VDO could be significantly reduced.

Keywords: Anthropometry, Ear length, Vertical dimension dental of occlusion, interpupillary distance.

1. Introduction

Determination of the vertical jaw relation is important for successful prosthodontic therapy for function, esthetics, and comfort to the edentulous patients. Many techniques have been used for measurement of the vertical dimension of occlusion (VDO), but there is no universally accepted or completely accurate method.¹

Vertical relation or vertical dimension refers to the degree of separation between the mandible, or lower jaw-bone and the maxillae, or upper jaw-bone² Presently, vertical dimension is measured based on physiologic references, such as physiological rest position, phonetics, swallowing threshold, and mechanical methods, such as use of pre-extraction records and ridge parallelism.³⁻⁷

Leonardo da Vinci and McGee correlated VDO with various anthropometric measurements. According to them original VDO is most often similar to the distance from the outer canthus of one eye to the inner canthus of the other eye, vertical height of the ear, twice the length of one eye,

horizontal distance between the pupils, and vertical length of nose at the midline.⁸

Variety of techniques being proposed and practiced for the evaluation of VDO, none of them is scientifically more accurate than other. Each method advocated has its own limitations. They are either time consuming, require special instrument/equipment, or expose patients to radiation.⁹ Furthermore, radiographic set up to provide lateral cephalographs¹⁰ or electromyographic machine¹¹ may not be available in most of the dental offices.

Before commencing the study, clearance from the Ethical Committee was acquired. Before starting the study, subjects were given detailed information about the procedure, and those willing to participate were included in the study

In line with these observations, this study is designed to assess the possibility of any relation between VDO and length of ear and interpupillary distance so that it can serve as a simple and precise method for estimating VDO. The landmarks used in the present study can be used more reliably since the

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dimensions of these will not change for the rest of the life of the individual, unless traumatized or pathologically involved.

2. Materials and Methods

For this study, 210 physically healthy dentate subjects comprising of 105 males and 105 females with the age range of 20 to 30 years having no deformity of ear or eye are selected randomly. All the participants have harmonious maxillomandibular jaw relationship and a definite centric stop with at least 28 fully erupted, periodontally sound teeth in both jaws. Subjects with the following conditions are excluded from the study: Open bite or deep bite cases, teeth anomalies, attrition, extensive prosthesis or restorations in the oral cavity, temporomandibular joint disorders, or any other pathology in the maxillofacial region, history of trauma, orthodontic treatment or orthognathic surgery.

All subjects provided written informed consent to participate in the study. Anthropometric measurements of vertical dimension of occlusion, length of ear, interpupillary distance are recorded clinically in millimetres using a digital vernier calliper.

To record VDO, the subjects are instructed to bite lightly on the posterior teeth with lips in repose and head well stabilized. We modified the tips of digital vernier calliper for recording VDO to allow a precise position in horizontal and vertical planes without causing any discomfort to the subjects. The lower modified extended tip of calliper is placed firmly tip of the chin (mental protuberance) Now the upper tip of calliper was raised until it lightly touched the base of nasal septum and the measurement was made (Figure 1).

For proper visibility of right ear, subject is asked to tilt his/her neck on left side so that the right ear has a better visibility and comfortable accessibility for measurement. Length of the ear is measured from the highest point on curvature of the helix to the lowest point on border of the lobule. The reading on the calliper are noted (Figure 2).

To measure the interpupillary distance, ask the subject to look straight ahead. Gently place the calliper tips near the centre of each pupil and record the measurement in millimetres (Figure 3).

Similarly, readings are taken by following the above-mentioned procedure for all the remaining subjects. These readings are used as data to calculate the mean, standard deviation (SD), and standard error for all the parameters. Data were statistically analysed using Pearson's correlation test used to find the association between the VDO and the length of ear and interpupillary distance.



Figure 1: Measuring VDO



Figure 2: Measuring length of ear



Figure 3: Measuring interpupillary distance

3. Results

Total 210 subjects (105 male and 105 female) were recruited for the study. Within the male subjects selected, the mean VDO was found to be 65.12 ± 4.17 mm and in female subjects it was 61.78 ± 5.81 mm (Table 1). The mean length of little finger within males were calculated to be 57.45 ± 4.79 mm, and in females it was 53.16 ± 3.75 mm (Table 1). The mean length of ear within males were calculated to be 63.01 ± 4.11 mm, and in females it was 65.16 ± 6.13 mm (Table 1). The mean value of interpupillary distance within males were calculated to be 62.02 ± 4.39 mm, and in females it was 62.99 ± 5.13 mm (Table 1).

- Pearson correlation test showed VDO in males has strong coefficient correlation with the length of the ear, $r = 0.341$ (moderate positive correlation) (Table 2)

- In females VDO has strong correlation with interpupillary distance, $r = 0.426$ (moderate positive correlation) (Table 3)

	Male Mean (SD)	Female Mean (SD)	Unpaired t test	p value, Significance
Age (in years)	24.6 (3.22)	24.72 (3.36)	$t = -0.272$	$p=0.986$ (NS)
VDO (mm)	65.12 (4.17)	61.78 (5.81)	$t = 4.782$	$p<0.001^{**}$
Ear length (mm)	63.01 (4.11)	65.16 (6.13)	$t = -2.981$	$p=0.003^*$
Interpupillary Distance (mm)	62.02 (4.39)	62.99 (5.13)	$t = -1.464$	$p= 0.145$ (NS)

Table 2: Correlation of VDO (in mm), Ear length (in mm), Interpupillary distance (mm) in males respectively

Males	Pearson 'r' correlation	P value, Significance
VDO (in mm) x Ear length (in mm)	$r = 0.313$ (moderate positive correlation)	$P=0.045^*$ (Significant correlation)
VDO (in mm) x Interpupillary distance (in mm)	$r = 0.486$ (moderate positive correlation)	$P=0.024^*$ (Significant correlation)

Table 3: Correlation of VDO (in mm), Ear length (in mm), Interpupillary distance (mm) in females respectively

Females	Pearson 'r' correlation	P value, Significance
VDO (in mm) x Ear length (in mm)	$r = 0.341$ (moderate positive correlation)	$P=0.032^*$ (Significant correlation)
VDO (in mm) x Interpupillary distance (in mm)	$r = 0.426$ (moderate positive correlation)	$P=0.011^*$ (Significant correlation)

4. Discussion

The delivery of a complete denture prosthesis brings a noticeable sense of satisfaction to both the patient and the clinician. This feeling largely stems from the improvement in the patient's facial esthetics and the favourable overall outcome of the treatment. Achieving an appropriate vertical dimension of occlusion (VDO) is essential in this regard, as it significantly affects both the esthetic appearance and functional success of the prosthesis.

Many methods have been described for determining the VDO. The majority of these methods were primarily subjective in nature. They were based on the assessment of parameters such as esthetics, phonetics, swallowing threshold, and the patient's comfort level. Objective approaches involved techniques such as electromyographic

analysis, evaluation of biting force, and the use of facial measurements. While these methods yielded useful and dependable outcomes, the instruments required were sophisticated and therefore not practical for everyday clinical application.¹²

In this study mean value of ear in males is 63.01 mm and in females 65.16 mm. Mean value of interpupillary distance in male 62.02 mm and in female 62.99. Mean value of VDO in males 65.12 mm and females 61.78 mm. These readings were used as data to calculate the mean, standard deviation (SD), and standard error for all the parameters. Data were statistically analyzed using Pearson's correlation test used to find the association between the VDO and length of ear, and interpupillary distance. Pearson correlation test showed VDO in males has strong coefficient correlation with the length of the ear, $r = 0.341$ (moderate positive correlation) In females VDO has strong correlation with interpupillary distance, $r = 0.426$ (moderate positive correlation)

This method is attractive and practical because it is simple, non-invasive, economic and reliable. It also provides reproducible values for future reference without the use of radiographs or complex measuring devices. Another great advantage it enjoys over previous methods is that it does not require a great amount of time and expertise to master.

5. Limitations

- The limitation of this study was that it was conducted on small group having Angles class I molar relationship and other class of occlusions were not considered.
- So the findings cannot be applied on the population of other ethnic group having different types of occlusion.

6. Clinical Significance

- The landmarks used in the present study can be used more reliably since the dimensions of these will not change for the rest of the life of the individual, unless traumatized or pathologically involved.
- Parameters are easily accessible to the clinician and are static so that the time taken for estimating the exact VDO could be significantly reduced.

7. Conclusion

This study clearly showed that the length of ear in males and the interpupillary distance in females can be used as a measurement to determine VDO in edentulous patients. The above-mentioned regression model can also be used to determine VDO in edentulous patients with the help of length of ear, interpupillary distance

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