



Validation of the Distance between Upper Canine Gingival Margin Zenith to Ipsilateral Lower Canine Gingival Margin Zenith as Method for Determination of the Occlusal Vertical Dimension

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Abstract

Background: The vertical dimension of occlusion (VDO) is one of the most important parameters to consider for diagnosis and treatment planning in a prosthetic rehabilitation. Various methods to determine it have been proposed throughout the scientific literature, without establishing a universally accepted method. Various factors, such as the differences in the biotype and phenotypic characteristics of the patients in certain populations, could generate variations in the measurements obtained.

Objective: This study aimed to validate a method of evaluation and determination of VDO in subjects belonging to a particular population.

Methods: 142 individuals belonging to an Ecuadorian population with healthy and complete dentition were evaluated. The VDO was recorded by taking a distance from the gingival margin zenith of the upper canine to the gingival margin zenith of the ipsilateral lower canine.

Results: The results obtained were consistent among the evaluated subjects, determining an average value of 17 mm corresponding to the VDO. The higher frequency of individuals presented a value of 18 mm, which is in agreement with previous findings.

Conclusion: The method replicated in this study could be suggested as a valid reference for determining and evaluating VDO in patients with a normal occlusion, which would serve to diagnose and to plan future comprehensive restorative treatments.

Keywords: Occlusal Vertical Dimension; Vertical Dimension; Gingival Margin Zenith

Introduction

One of the influencing factors in the vertical position of the jaw is the vertical dimension (VD). According to the Glossary of Prosthodontic Terms, VD is the distance between two selected anatomic or marked points, one on a fixed and one on a movable member [1]. The decrease of VD, caused by various causes such as loss of dental pieces, loss of dental substance due to carious or non-carious lesions, defective restorations, premature contacts, bad dental position or inadequate prosthetic restorations, can negatively im-

part the patient from a functional, phonetic an aesthetic point of view [2-7]. Among the most important consequences of decreased VD are hyperactivity of the chewing muscles with associated muscle pain, alteration in occlusal forces, and temporomandibular disorders [8-10]. Depending on various reference factors, such as the position of the jaw and dental contact, the vertical dimension can be classified as: Face vertical dimension (VDF) or face height, which is the measure between the trichon and chin in the facial midline, further described as the sum of the upper, middle and lower facial

thirds [7]. Vertical dimension of occlusion (VDO) defined as the distance between two selected or marked anatomical points in the facial lower third when the dental arches are in maximum intercuspation [2,5,12-14] and vertical dimension at rest (VDR), which is the height of the facial lower third between two previously established marks, when the mandible is not in occlusion or resting position [5,14]. Another factor to take into account is the interocclusal free space (IFS), conceptualized as the distance between the occlusal surfaces when the jaws are in a resting position and is recorded as the difference between VDO and VDR [5]. From these definitions, due to the intervention of the dentist in diagnosing and planning a new treatment with a new VD, the VDO as a concept acquires special importance [8,9]. In oral rehabilitation, the VDO is not a specific point, on the contrary, it is an optimal adaptive space available, within which the clinician makes the decision to carry out prosthodontic treatment. This is because the VDO determination is considered a fundamental point at the beginning of oral rehabilitation treatments, seeking harmony between all the anatomical, physiological and neuromuscular elements. The therapeutic VDO in oral rehabilitation is determined, taking into account different factors, such as: overjet, overbite, space available for prosthodontic rehabilitation, mandibular morphology, profile and facial aesthetics, both vertical and horizontal skeletal biotype, in addition to systemic health status of the patient [5].

As mentioned about VD, VDO can also have variations, with factors that influence its decrease caused by dental loss combined with skeletal disharmony, dental wear, dental migration and iatrogenic procedures. The VDO of a patient can be determined by a record prior to dental loss, or by determining the VDO after tooth extraction or dental extractions or loss of areas of the dental structure that support the patient's occlusion [2]. Importance of the occlusal relationships between the maxillary and mandibular first molars according to the Angle classification and their direct relationship with the vertical plane, since variations and characteristics of their own have been reported in patients according to their skeletal and molar class, must be emphasized [11].

The determination and control of the VDO is relevant and important in practically all areas of dentistry [2,7]. Based on the aforementioned, it should be noted that for oral rehabilitation, it is necessary to reestablish the VDO as a zone [5] to define the limits allowed in prosthodontic treatment. Several methods have been established to establish VD in dentate patients who will undergo a

new comprehensive treatment that modifies occlusal schemes, assuming that VDO with full dentition is ideal in terms of aesthetics, function and comfort. Among these methods, the registry of intra-oral measurements is reported, which examines existing measurements between two marked points in the maxilla and mandible, in maximum intercuspation, and the outline of the profile of the lower facial third using a position template. Any of these records must reproduce the lip position as a guide for the position of the anterior teeth. The objective is to reproduce the facial sagittal plane and the height of the lower third when performing the restorative treatment. Another method is the cephalometric study that requires a pre-extraction lateral cephalic radiography and another post-extraction with occlusal stems. These two radiographs are compared, and the impellers are adjusted until the proper position is found.

The pre-extraction phonetic analysis has also been described where the patient is in maximum intercuspation and a line is drawn on the mandibular incisors following the incisal edge of the maxillary incisors establishing the VDO. Next, the patient pronounces the "s" phoneme in a sustained manner and the same trace is repeated on the lower incisors at the new level, which is equivalent to the VDR. Finally, the space between these two lines (IFS) will be recorded to be reproduced in subsequent prosthetic treatments [2]. Although there is no universal and scientific method for evaluating and recording VD, its accuracy is key to the success of the treatment [15]. Regarding the use of natural teeth parameters to determine the vertical dimension, there is an antecedent of a study using measurements on posterior teeth, suggesting its application in the positioning of artificial teeth in edentulous patients [16]. Finally, another method contemplates the intraoral evaluation of the VDO by measuring the distance between two anatomical reference points. An upper one, in the cement enamel junction (CEJ) or in the gingival zenith margin (in the absence of gingival recession or periodontal illness) from the upper canine to the same point of the ipsilateral lower canine in patients with first skeletal class [13]. A quantification of this measurement less than 18 mm could determine loss of VDO [12]. However, this measure has not been determined for our particular population considering the importance of ethnic variations to establish an evaluation parameter of VD [17].

Aim of the Study

This study aimed to validate the prevalence of this measure, taking into account patients with the same racial, anatomical and morphological characteristics, as a method of determining and

evaluating the VDO in dentate patients or for planning treatment in oral rehabilitation.

Methodology

142 individuals, 106 women and 36 men with an age range between 18 to 31 years, dentate, bilateral molar class I, with full dentition and without signs of loss of dental tissue and healthy periodontium (that was evaluated previously) were examined after explaining the scope of the study. All of them, once a cheek separator was placed, were asked to bite in the usual occlusion and the intraoral measurement was taken with a dry tip calibrator (Rotring, Mod. S0676530), taking the gingival zenith (or CEJ) of the maxillary and mandibular ipsilateral right and left canines as reference points (Figure 1). The marked distance was measured with a digital caliper (Stanley, 78-440). The results were recorded in a database created by a program (EXCEL, Microsoft 2020), with the gender, age, left VDCEJ (LVDCEJ) measure and right VDCEJ (RDVCEJ) measure collected from all the patients examined. Using the IBM SPSS Statistics 20.0 program, mean, maximum and minimum values, and standard deviation were determined.



Figure 1: Measure of VDO between upper canine gingival margin zenith to ipsilateral lower canine gingival margin zenith.

Results

284 measurements were obtained in 142 subjects. The range of measurements of LAC to LAC of the ipsilateral canine ranged from 12.46 to 21.36 (Table 1). The average distance of all measurements was 17.18 mm. The frequency of the findings in the studied subjects was higher with a measurement of 18 mm (Graph 1). There were slight variations in terms of gender (Table 2) and the influence of age did not show significant changes in the measures (Table 3).

	Subjects	Mean distance	Minimum	Maximum	DS
VDOR	142	17.11	13.00	21.36	1.83
VDOL	142	17.26	12.46	20.50	1.77
VDOT	284	17.18	12.46	21.36	1.80

Table 1: Distance values from LAC from upper canine to LAC of ipsilateral lower canine.

Gender	Subjects	Mean Distance	Minimum	Maximum	DS
Male	36	17.67	13.00	21.36	1.77
Female	106	17.01	12.46	20.50	1.78
Total	142	17.18	12.46	21.36	1.80

Table 2: Distance values from gingival margin zenith from upper canine to gingival margin zenith of ipsilateral lower canine and gender analysis.

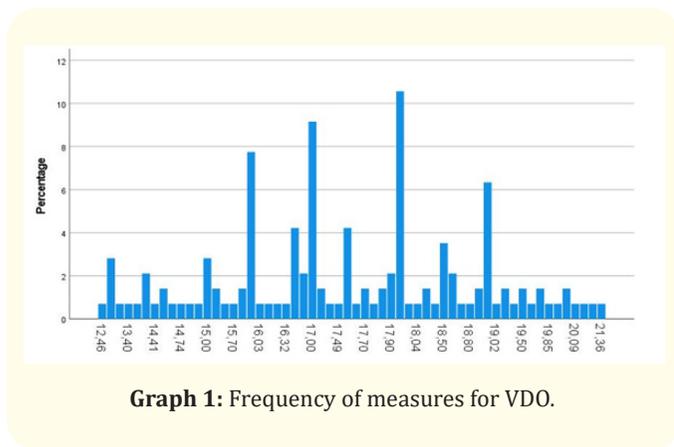
Age	Subjects	Average	Minimum	Maximum	DS
18	16	17.61	14.77	20.50	1.46
19	22	17.63	13.69	20.09	1.87
20	18	17.18	14.74	19.00	1.46
21	12	17.06	13.00	19.55	2.20
22	18	17.57	14.00	19.60	1.59
23	18	16.32	12.46	19.20	2.06
24	18	16.44	13.00	19.00	1.90
25	14	17.30	14.65	18.00	0.99
26	4	16.62	15.50	17.50	0.79
31	2	20.60	19.85	21.36	0.87
Total	142	17.18	12.46	21.36	1.80

Table 3: Descriptive values of the distance from gingival margin zenith of upper canine to gingival margin zenith of ipsilateral lower canine and age analysis.

	Subjects	Differences	Minimum	Maximum	DS
*VDOR+	46	0.84	0.02	2.00	0.56
**VDOL+	64	0.95	0.10	2.01	0.56
**VDOT	110	0.91	0.02	2.01	0.56

Table 4: Descriptive values of the differences of the distance from gingival margin zenith of upper canine to gingival margin zenith of ipsilateral lower canine and in the same subject.

Analysis of difference in measurements per side. *When the value of right side is higher. **When the value of left side is higher. ***Analysis of total difference with both sides.



Graph 1: Frequency of measures for VDO.

Discussion

This study showed consistent results in the intraoral evaluation in millimeters of the vertical dimension of occlusion, taking the gingival margin zenith or the CEJ of the upper canine and the ipsilateral lower canine as anatomical references in a given population. Various methods have been tested for the determination of the VDO. However, in some methods the variations that can exist when taking skin points as references can generate inaccurate results [13]. Pretreatment records, old diagnostic models and previous photographs have also been suggested [18]. Biometric measures such as that of the present study were initially proposed to measure the severity of tooth wear [19]. Among its disadvantages, the difficulty of measuring the loss of VDO at the time of diagnosis has been mentioned, in addition to the fact that this parameter may be affected by an inadequate relationship of the anterior teeth [12]. However, the objective of this study was to obtain a validated measure for a particular population, for treatment planning and final evaluation, taking into account patients with an occlusion and optimal relationships between the anterior teeth. The mean of the dimension evaluated was slightly higher for male patients (0.66 mm) in relation to women, and clinically not significant, even though the sample of men was smaller and not comparable to that of women. The ranges presented important extreme values, so other factors should be considered when obtaining them (height, physical build, facial characteristics). The variations between the left and right sides of the same patient were less than 1 mm, being clinically not significant. The total mean of the biometric measurements left a value (17 mm) slightly lower than that reported in a literature review article. Although the highest percentage of patients in the present study presented a value of 18 mm, being in agreement with what was re-

ported in review of the literature on the methods of evaluation and determination of the VDO [12]. It is important to highlight that the proper characteristics and facial features of a common population could determine that, in this geographic region, this measure can be applied clinically as a predictor or comparison value of an VDO with normal parameters. The age of the participants in this study, all with oral health, healthy periodontium and complete teeth, was not an influencing factor in the measurement variations, although it should be clarified that the VDO can be altered due to the loss of dental tissue in different settings, without being this the objective of this research.

The clinical disadvantages of other methods to determine the VDO for example with the pronunciation of certain phonemes lie in their subjectivity [18,20-24]. Assessment of the physiological position at rest, neuromuscular assessment [12,20,25,26] and assessment of facial tissues and muscles [12] can be challenging for inexperienced clinicians. Radiographic evaluation requires complementary studies, which are more expensive and may involve unnecessary radiation for the patient, with this objective only [12,20,27]. The facial morphological proportions [20,28] are also subjective and can be interpreted in different ways, depending on the variability of the examination and the methods to carry it out. Other methods such as the distance between the external angle of the eye and the lip commissure and its equivalent to the distance between the base of the nose and the chin; or the determination of the VDO after swallowing saliva can be misidentified and has been recommended mainly for edentulous patients and for the planning of treatment with complete dentures [20,28,29]. In a biometric measurement such as the one in the present study, the gingival margin zenith or the CEJ of the superior and inferior canine are two specific points that are easy for the clinician to locate, even when they have little experience. The position of the patient in maximum intercuspation can be easily evaluated. Additionally, it could be recommended through this method, the determination and confirmation in digital models or physical study models mounted on a semi-adjustable articulator, both in the diagnostic stage and in the planning of rehabilitation treatment. In addition, it could be recommended to apply this method in a functional mock-up, evaluating the VDO in the planning performed. The importance of previously determining that the patient's skeletal and molar class is confirmed as class I should be mentioned in order to apply the described methodology.

Conclusion

After considering this study and its limitations, the biometric measurement between the gingival margins or CEJ between the antagonistic ipsilateral canines in class I patients could be validated to evaluate and determine the VDO. A larger study using this methodology is recommended to ratify these results.

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