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Research Article

The minimum phonetic dimension in total edentulous patients: a different method for determining the vertical dimension of occlusion

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Abstract. Introduction: The vertical dimension of occlusion, describing the vertical position of the mandible with respect to the maxilla when the upper and lower teeth are intercuspated at the most closed position, is an essential parameter in dentistry, in particular for prosthetics. The classic method to determine the vertical dimension of occlusion is a static one, based on the determination of the rest vertical dimension, which is imposed by the balance between the two opposite muscle groups of the mandibula (elevators and depressors). The aim of the present work is to probe a new method based on dynamic principles, using phonation for determination of the vertical dimension of occlusion in total edentulous patient. Materials and methods: This method consists in using hard material custom trays. The maxillary custom tray is bearing an occlusion rim made of pink wax which assures the vestibular curvature according to aesthetic criteria and the occlusal plane. The mandibular tray will be used with a soft roll of material to take impressions during phonation. Special sounds are used during the procedure in order to obtain the minimal phonetic vertical dimension. The proposed method had been tested on a group of ten denture-bearing patients having total bi-maxillary edentation. Results: After treatment, facial aspects showed that lip contours are improved, the facial ratios appear to be proportional and the speech was similar to persons with natural teeth. Conclusion: The minimum vertical dimension has been proven to be a valuable method. This method eliminates the evaluation errors, reduces treatment time and demonstrates practical feasibility.

Key Words: dimension of vertical occlusion, minimal phonetic vertical dimension, total edentulous patients, phonation, centric relation.

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Introduction

It is well known that for a successful treatment of bimaxilary edentation, one of the milestones is a correct determination of the vertical dimension of occlusion, which has to be the same as before edentation occurred. The vertical dimension of occlusion (VDO) is an essential parameter in dentistry, in particular for prosthetics. The vertical dimension of occlusion refers to the vertical position of the mandible in relation to the maxilla when the upper and lower teeth are intercuspated at the most closed position. The repetitive contracted length of the elevator muscles determines the vertical dimension of occlusion (Dawson 2006). Methods for determining vertical dimension of occlusion mostly date back to the early 20th century (Pound 1976). Techniques for determining VDO are numerous and are based on the determination of the rest vertical dimension (RVD) (Niswonger 1934, Pleasure 1951), speaking methods (Pound 1977, Silverman 1953, Silverman 1956) preextraction registration techniques (Smith 1971), photographs (Bliss 1935) measurements of face and intraoral measurements (Willis 1935), cephalometric radiographs (Pyott et al 1954) etc.

Determination of the dimension of vertical occlusion in total edentulous patients continues to be a hotly discussed topic in literature since there is no reliable and universally accepted method for resolving it (Bratu et al 2003, Sigurd et al 1983, Lejoyeux 1968). As it is a step of major importance, which precedes the correct account of the centric relation (CR), there is currently still high interest in finding new approaches. The current methodology involves two branches: (1) using physiological methods at the expense of anthropometric (mechanical) ones, and (2) optimal timing determination in successive stages of treatment (Negucioiu 2004, Păuna et al 2005, Klein 1974). Some of the ideas shared at the Cluj School of Dental Prosthetics focus on finding dynamic functional methods for determining the VDO, complementing the functional static methods used to date. At the national level, for the first time, we encounter the use of phonation in determining the VDO. We believe that an in-depth analysis of this valuable approach could bring new therapeutic benefits for total edentulous patients.

It is generally agreed that there is a corresponding position of the mandible in the relation to the maxilla for each sound. According to Survin (Survin 1988) "M", "F" and "S" are the most appropriate consonants for testing. Head position has a significant impact on the size of free interocclusal space if VDO is determined by facial aspect, while using the phonetic method,

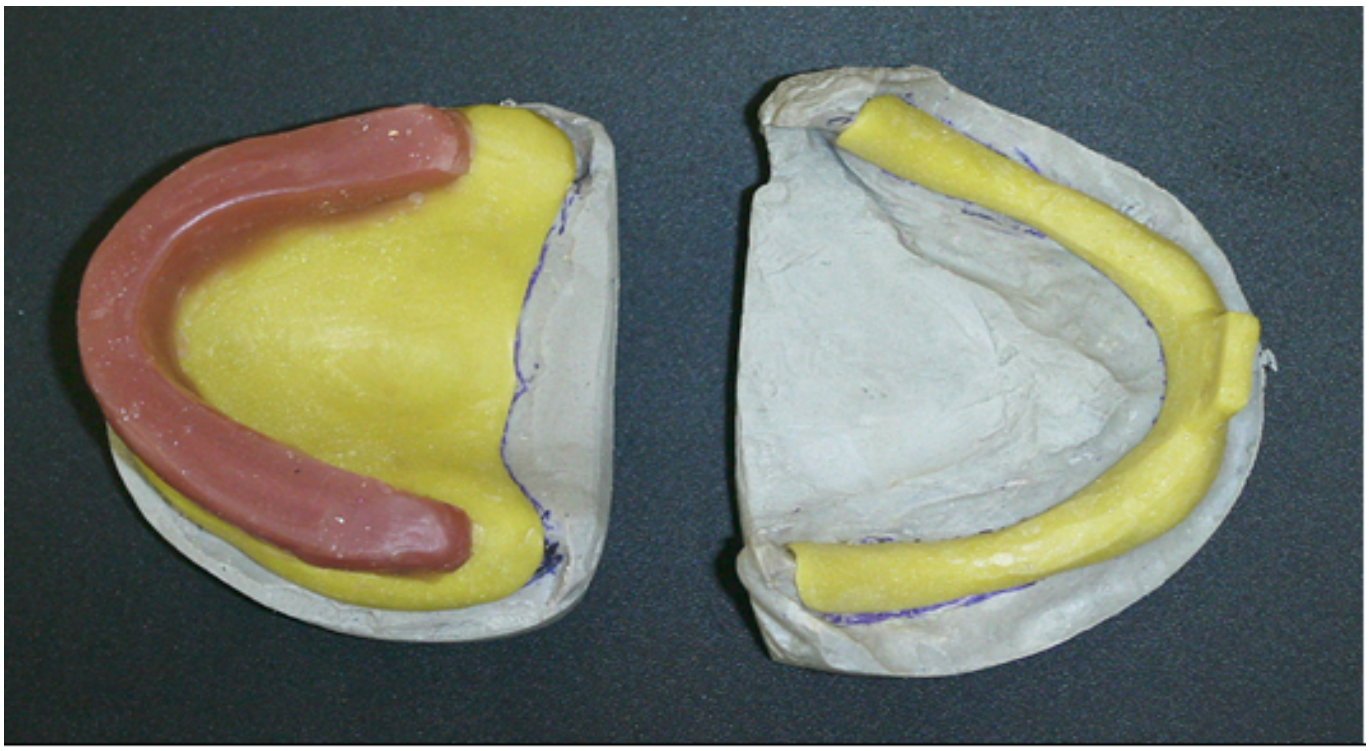

Fig. 1. Individual trays made for the particular purpose to determinate the vertical dimension of occlusion by the phonetic method. Upper rim made from pink wax

Fig. 2. Mandibular custom tray made from Duracrol

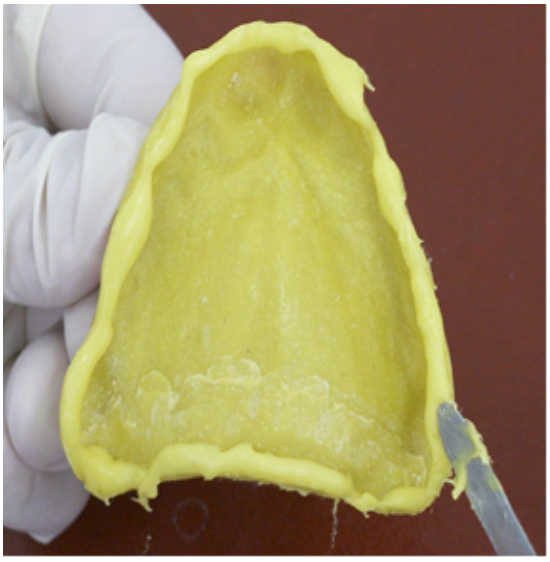

Fig. 3. Internal border closure of the maxilla custom tray for optimal maintenance to the prosthetic field

the size of the free interocclusal space remains constant at different positions of the head (Čelebić et al 2003).

The purpose of our work had been to use and probe the phonation as a functional method for VDO determination, as well as to develop a new feasible technique with practical relevance for determination of VDO during the functional impression appointment.

Materials and Methods

The research had been conducted on a group of ten completely edentulous patients (men and women) who had requested prosthetic restorations. The participants had given their informed consent before taking part in this study as well as the project obtained the ethical approval of the department (No.70/14.12.2016). The investigation has been focused on the functional impression appointment. For this reason, the dental technicians were asked to make custom trays in a distinctive manner. Thus, the bases of the custom trays were made of a hard material, for instance, Duracrol (SpofaDental, Czech Republic). The individual trays are presented in Fig. 1.

They were designed with an occlusal rim made of pink wax for the maxilla as well as with a front handle for the mandible. When the mandibular edentulous ridges were wide, the custom trays were designed with finger rests, which had to be shorter

than the teeth from that respective area, as well as narrower than the width of the ridge (Fig. 2).
The vestibular curvature of the occlusal wax rim had been modeled according to aesthetic criteria and the occlusal plane (OP) has been determined (height and orientation). For the mandibular custom tray, handle should be positioned so that it does not interfere with placement of tray or border molding procedures. Finger rests were adapted when necessary and the tray's length has been adjusted in order to achieve the internal border closure. The minimum phonetic vertical dimension (miPVD) was recorded. The steps followed during this procedure included the application of a soft roll of Duracril (SpofaDental, Czech Republic) in its plastic phase over the surface of the mandibular tray. Its width did not exceed the thickness of the ridge while the height was slightly larger than that of natural teeth. This soft strip of acrylate was used in order to come in contact with the wax rim of the maxillary tray, so that it could be molded.
Both trays were inserted into the oral cavity and the occlusal area of the mandibular wax rim was self-modeled during phonetic movements, with the aim of raising the mandible toward maxilla until the minimum phonetic vertical dimension (miPVD) had been achieved. In order to do this, the patients were asked to pronounce phonemes equivalent to "S" and "I", taking advantage of the fact that these phonemes raise the mandible toward maxilla. We instructed the patient repeatedly pronounce the syllables, "Si-si-si…", until the acrylic resin became hard. In Fig. 4 we show the modeling of the occlusal surface of the mandibular border done as described above.
The minimum phonetic vertical dimension registered in this manner represents the sum of two vertical dimensions, miPVD=VDO+ miSS where miSS represents the minimum speech space. Using this relation, we determined the vertical dimension of occlusion as VDO= miPVD- miSS. From the recorded values of miPVD we subtracted miSS that is normally about 1÷1.5 mm. Since this subtraction is easily applicable on patients, we performed intraoral tests to verify the minimum speech space. During phonation, the occlusal rims were not allowed to touch each other and the patient had to feel comfortable. To accurately ensure the existence of the minimum speech space, we performed some tests using soft red wax that was applied on the left and right sides of the mandibular occlusal rim. For the maxillary and mandibular functional impression, we reduced an additional 2 mm from the height of the mandibular occlusal rim. This reduction was equivalent with the thickness of the impression material. Maxillary and mandibular functional impressions were attained using combined closed-mouth and open-mouth techniques. The maxillary impression was taken first, followed by the mandibular one and finally the centric relation (CR) had been determined. The assembly has been fastened and sent to the laboratory. The dental technician made the final casts and mounted them into non-adaptable and semi-adaptable articulators (Fig. 5). Then, the dental technician manufactured the try-in dentures.

Fig. 4. Occlusal surface of the mandibular border after using the phonetic method of determining the vertical dimension of occlusion

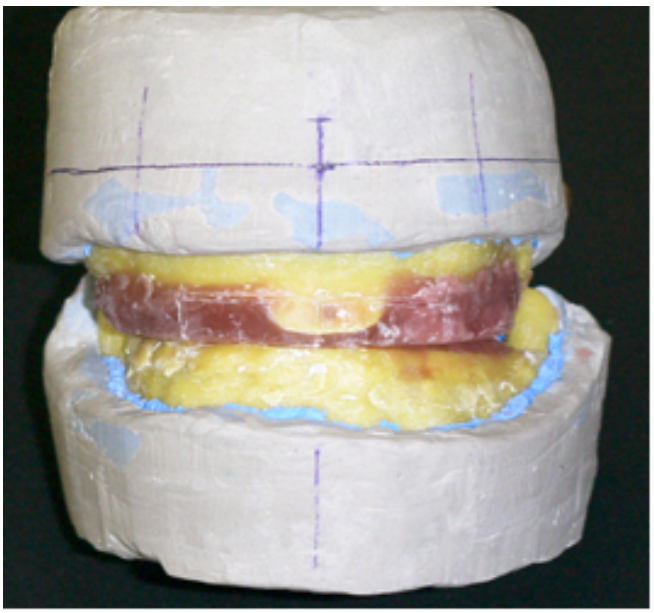

Fig. 5. Intermaxillary relation, the occlusal rims are fastened on the casts

Results

In Fig. 6 and Fig. 7 we illustrate the obtained results. The comparative images show the facial aspect before treatment (without dentures) (Fig. 6) and after treatment (with dentures inside the mouth) (Fig. 7). In Fig. 7, we observe a clear improvement of the facial features. The lip contours are modified and the face ratios appear to be proportional. The phonetic tests performed at the moment of denture application into the oral cavity and two weeks thereafter reveal the existence of a minimum speech space; this is also known as the physiological space of disocclusion or the comfort zone during phonation.
A major concern that is addressed in this work is to point out the advantages of this new technique over more traditional methods such as anthropometric measurements (Farkas et al 2005) and swallowing (Fayz et al 1988). The obtained results show some important advantages as compared with the above techniques. In practice, the classic procedure uses the mandibular resting position for determination of VDO. This is a physiological method

Fig. 6. Facial aspect before treatment

Fig. 7. Facial aspect after treatment

that is relatively easy to be performed and got a widespread support. However, it has been criticized for being a static position, which is not in agreement with the idea that the mandibular rest position is actually a dynamic one. Consequently, errors may arise while using the classic technique (Bratu et al 2003). The phonetic technique proposed by us is indeed a dynamic method as well as a functional one, which is done with the active involvement of the mobilizing muscles of the mandible. Using phasic-muscle activity, namely the one related to movement and not tonicity, we place the muscles in agreement with the optimal contraction length of the elevators muscles of the mandible that contribute to the phonation act. The contraction of the elevators muscles of the mandible from dynamic-phonetic phase is less exposed to the errors than into the tonic phase. Research findings have confirmed this. Compared with the phonetic technique for determination of VDO described by Iuliana Săbăduș (Săbăduș 1995) and Maria Negucioiu (Negucioiu et al 1984), our technique represents a novel method that is more reliable from the practical point of view. The cited authors essentially use a support base that is also part of the base of the final denture and not only of the custom trays. This action alters the moment in which the VDO is determined into one as part of a different work phase. Besides, the authors make the self-modeling using soft acrylic rims for both maxillary that is rather more complicated.

The technique that we described allows the VDO to be determined into an early phase of total edentulous treatment (functional impression stage) for the first time. By determining VDO and the centric relation during functional impression phase, the number of treatment steps is reduced from five to four. Consequently, the amount of working times for both the dentist and technician are reduced whereas the laboratory starts directly with the try-in dentures.

In this technique appear simplified elements as self-modeling of the mandibular rim but not for maxillary rim. Manufacturing the maxillary occlusal rim from wax and not from acrylic as well as self-modeling presents some advantages: (1) it shortens the working time and (2) the modeling of the vestibular curvature of the frontal wax rim is more precise than the one obtained by self-modeling. However, when using the phonetic modeling, there is the risk of an excessive modeling, with the flattening of the vestibular face of the rim, generated by the contraction of the upper lip orbicular muscle.

By determining the occlusal plane on the maxillary rim and not on the mandibular rim, more conclusive data regarding the mounting of the teeth, especially for those in the frontal area, are achieved.

Conclusions

The method for estimating the VDO started with the determination of the minimum phonetic vertical dimension as a functional method, which yielded good results.

The phasic activity of the muscles involves them into dynamic activity, according to the optimal length of contraction of the elevator muscles of the mandible, thus eliminating VDO estimation errors from the tonic phase of muscular activity. The dynamic technique for determining the VDO helps prevent overestimating the VDO. Determining the VDO in the functional impression stage is feasible and beneficial. It streamlines and increases the efficiency of the clinical and technical treatment stages. From the practical point of view this technique is realistic and clinically reliable.

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