

# Development of Phonetic Tests in Order to Improve the Functional Impression Technique in Total Edentation

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## Abstract

This study is based on the idea that muscles on the periphery of total edentulous prosthetic field as well as the muscles mobilizing the mandible could contribute to a greater extent to the improvement of the quality of prosthetic part created. In this paper the authors aims on the basis of an interdisciplinary phonetic study in general linguistics to develop phonetic tests capable of modelling in the best conditions the edges of the mandibular port-imprint and the entire neutral zone of the dental corridor. The study included 20 patients, consisted of 10 females and 10 males. All the subjects are edentulous patients uni or bimaxillary and required complete dentures. We present the choice of phonetic tests for modelling lateral functional mandibular areas (buccal and lingual) and we select the most suitable isolated phonemes, and phonemes assembled a certain order, in order to give greater strength to the modelling power of the imprint. The average value obtained for the vertical dimension of occlusion are 64,4 mm for males and 58,1 mm for females. As a conclusion we can say that the use of phonetic method for determining the vertical dimension of occlusion and for modelling the edges of the custom tray is simple and easy to perform.

**Keywords:** phonetic tests; dental corridor; complete dentures; total edentulous.

## 1. Introduction

Speech area (SA) is the distance between the occlusal surfaces of antagonistic teeth during pronunciation of certain voices [1].

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Jaw relationship when making complete dentures, should be reconstructed with artificial dental arches in the proper vertical and horizontal relationships.

Mehringer [2] said that tooth loss does not affect the speech position of the mandible but many authors used different sounds for determining the vertical dimension of occlusion in edentulous people. Morrison [3] proposed the use of English words “sixty-six” and “Mississippi” to determine the VDO, Sharry [4] determined VDO by phonetic method using Arabic words and Pound [5] proposed the method of counting from 50 to 55 for determining the VDR.

The hypothesis from which we started in this study is based on the idea that muscles on the periphery of the total edentulous prosthetic field as well as the muscles mobilizing the mandible could contribute to a greater extent to the improvement of the quality of prosthetic parts made by using phonation as a means of therapy. We expect that the beneficiaries of these prostheses are elderly patients who, for various reasons, cannot be treated with supra-implanted prosthesis.

The objective of this paper is to achieve an interdisciplinary phonetic study on the basis of which we can develop phonetic tests capable to mould, in the meeting for the final impression, under the best conditions, the edges of the custom tray and the entire neutral zone in which the future dental corridor is inscribed.

## **2. Material and methods**

The study included 20 patients of the Prosthodontics Clinic of “Iuliu Hatieganu” University of Medicine and Pharmacy from Cluj-Napoca, 10 females and 10 males with uni or bimaxillary total edentation. All the participants were informed about the nature of the study and gave their consent for participation in the study.

Our initiation as prosthetists in phonetic problems regarding the correct positioning which must be achieved by the articulatory organs of the mouth (joint), and also the mechanism designed to deliver, to utter sounds, words, sentences (pronunciation), is required for the research which aims at using the phonation as direct means of therapy and not as an auxiliary means of therapy. In this respect we benefited from the publications of experts in general linguistics who study language in terms of its general features [6-10].

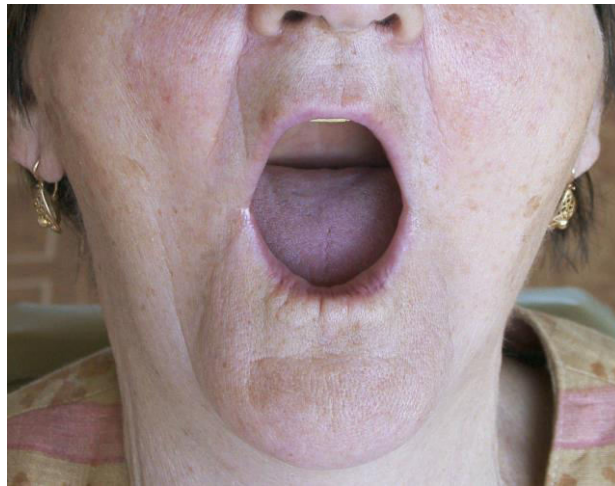
The working method consisted in knowing the rules of correct pronunciation of all phonemes in Romanian language (orthoepic rules) [11], based on which we can select the most suitable isolated phonemes and phonemes which we can assemble in a certain sequence with the purpose of giving greater strength to the modelling power of the imprint. In addition, the study conducted brought before us, as prosthetists a lot of new terms that we had to acquire, and use in the vocabulary which will be used for the choice of phonetic tests.

In this paper we shall present the elaboration of phonetic tests for the lateral areas (vestibular and lingual)

1. Vestibular lateral areas. They will be modelled by stretching movements and buccinator muscle contraction movements, which forms the inner wall of the cheek.

The buccinator muscle stretching is performed only by uttering rounded labial vowels "o" and "u". There are no rounded labial consonants.

Vowel "o" is semi-open, post-palatal, with a frequency of use in Romanian of 2.66% [6-8]. During the correct pronunciation the tongue is withdrawn, the tip of the tongue is lowered in the mouth floor and the posterior side is raised towards the soft palate (**Figure 1**). The lips are rounded forming a vertical distance between lips of about 10 mm [6-8]. The cheeks will appear hollowed and will exert slight modelling pressure on the imprint material. Since the distance between the mandible and maxilla is relatively high, we recommend using the vowel "o" when the physician provides digital support for the port-imprint, on the pressure buttons.



**Figure 1:** Female patient pronouncing "O"

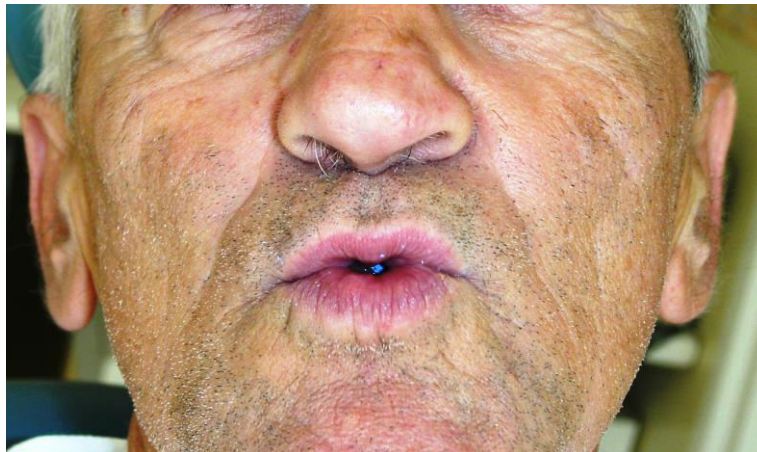
In the cases we have a maxillary occlusal pattern, previously modelled according to the level and direction of the occlusal plane, the modelling can be continued with vowel "u", which has a greater modelling force than "o" [12].



**Figure 2:** Maxillary occlusal plane

This is a closed vowel according to the openness of lips (3mm) degree, which prevents the lift of the port-imprint from the support area of the prosthetic field. Additionally, vowel "u" has a high frequency of use. (5.83%)[6,7,10].

To strengthen the modelling performance we shall ask the patient to utter an extended "oooo" uttered with intonation, as if he/she expresses a surprise, after which he/she will deliver an extended "uuuu" miming a rumble (**Figure 3**).



**Figure 3:** Male patient pronouncing "UUUU"

The buccinator muscle contraction or the pulling of the mouth corner towards the posterior side can be accomplished by issuing the vowels "e", "i" and the consonant "s". "e" and "i" are anterior vowels, where the tip of the tongue comes into contact with the middle third of the palate, more relaxed for "e" and more tensed for "i". If the mouth has an average opening (5-10mm between lips) sound "e" is formed and if the mouth has a small opening (2-3mm) sound "i" is formed [6,7,8]. During the pronunciation of "i" the tongue presses harder on the palate and behind the incisor tooth and the corners are more withdrawn and slightly higher. Both vowels have a high frequency of use in Romanian: 10.14% for "e" and 6.52% for the "i". For these reasons we chose to perform the imprint modelling by uttering the sounds "eeiii" as a reproach. Placement of "e" before "i" will increase the effect of modelling of the vowel "i" as articulatory bodies are prepared for the uttering of "i" along with the uttering of "e". We gave up using the consonant "s" because it will be needed in the next stages of the moulding, thereby influencing the lateral vestibular areas. So, for the stretched buccinator muscle dynamics we shall use rounded labial vowels "ooo" (surprise) and "uuu" (rumble) and for the contracted muscle we will utter vowels "eeiii" (form of criticism) (**Figure 4**).

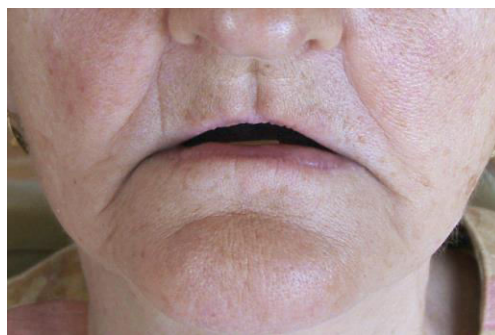
2. Lateral lingual areas (left and right). They will be modelled immediately after modelling the lateral vestibular areas. For this purpose patients will have to sing phonemes designed to widen the tongue and lift the mouth floor. From the studies performed we found that the only phoneme that meets these requirements is consonant "L". When pronouncing consonant "L" the tongue performs one of the most various contacts with neighbouring areas. We must keep in mind that it is a semi-occlusive consonant which has two moments of articulation and a sonant consonant, causing greater muscle tension. In the first moment of articulation of consonant "L" the lips

open, the tip of the tongue is placed firmly on the maxillary dental alveolar area and the dorsal side occupies the central area of the palate (**Figure 5**). At this time the tongue widens and the mouth floor rises, modelling the edges of the port-imprint and its lingual side. During the second moment of articulation, the opening of the articulators is slow, where the expiratory airflow flows down the sides of the tongue. During this second moment we will have to intervene with other phonemes, to maintain the modelling previously developed, but also to perfect the balance of power between extra-buccal and intra-buccal muscles.



**Figure 4:** Female patient pronouncing “eeeiii”

To this end consonant "L" will be combined with the vowels "E" and "I", which as we have seen, have shaped the lateral vestibular areas, with the buccinator muscle contraction. By means of the position of the tip of the tongue placed behind the lower incisors and the dorsal side of the middle third of the palate, vowels "E" and "I" widen the tongue body. For the modelling of the lateral lingual area we recommend the uttering of two words, namely: "ELLI" and "LILI", which will be repeated three times in an energetic and clear manner. We chose his sequence of phonemes by considering a basic rule of phonetics which says that when a phoneme is pronounced the position of lips and the spacing between the teeth depends on the sound that follows. In this case "E" is placed before "L" because both sounds are semi-open. So "E" will prepare the correct position of the mandible for the uttering of "L". At the time of uttering consonant "L", the mandible and mouth corners are already prepared for the uttering of "I" (the lifting of the mandible with raised and withdrawn corners is characteristic for vowel "I").



**Figure 5:** Female patient pronouncing “L”

Vowels "E" and "I" preceding and following after "L" will model both sides of the border through a synergistic and contrary action. This stabilizing effect will enhance the modelling capability of consonant "L", which will create the necessary space for the tongue and will delineate the lingual edges of the imprint in the high floor position. The final effect of the prosthetic part in the mouth will be one of comfort of tongue both in the rest position and during phonation.

### 3. Results

In this study, an equal number of males (10) and females (10) were included. The mean age was 69 and ranged from 37 to 87 years (**Table 1**). The mean VDO for female was 58,1 mm and 64,4 mm for male. The values of the distance between VDR and VDO was 2-3 mm.

**Table 1:** VDR and VDO for males and females included in study

MALE				FEMALE		
Nr. Crt	Age	VDR (mm)	VDO (mm)	Age	VDR (mm)	VDO (mm)
1.	73	65	63	78	61	58
2.	65	66	64	76	61	59
3.	66	67	65	71	59	57
4.	63	63	61	67	61	58
5.	75	73	70	72	60	58
6.	58	74	72	69	62	59
7.	61	68	66	37	62	60
8.	70	60	57	75	58	56
9.	68	65	63	77	63	61
10.	77	66	63	87	57	55

### 4. Discussion

The ideal method of restoring VDO has not been found. There are several techniques and this include the use of anterior teeth measurements [13], closest speaking space [14], swallowing method [15], patient's neuromuscular perception [16], cephalometric radiographs [17], intraoral and extraoral anatomic landmarks [18] and measurements of fingers [19].

The distance between VDR and VDO varies according to different authors: we found in our study that VDR-VDO=2-3 mm, about 3mm according to Niswonger [20] and about 2,16 mm according to Igić and his colleagues [1].

The limitation of our study would be the number of the patients. Our sample was limited to patients from the

Prosthetic Department of University of Medicine and Pharmacy “Iuliu Hatieganu” of Cluj-Napoca, Romania. Another constrain of the study was the patient age that limitates mobility, activities of daily living and physical performance and hampers the treatment stage.

## 5. Conclusion

The phonetic method for determining the VDO and for modelling the border of the custom tray is simple and does not require special equipment or training of the doctors.

The initiation of the prosthetists in a phonetic interdisciplinary study could be a breakthrough for improving prosthetic therapy methods in total edentation.

The study performed brings convincing phonetic arguments so that phonation can be used as a means of therapy in total mandibular edentation and not only as a means of verifying the therapy. We recommend the use of phonation for functional impression in order to improve the adhesion and suction of dentures.

The elaboration of interdisciplinary studies will create new connections, with beneficial effects for the theory and practice of the prosthetist. Phonetic tests proposed for the functional imprinting and neutral zone is an argument in this regard.

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