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Effects of different complete dentures base materials and tooth types on short-term phonetics



Khalid A. Arafa, PhD

Department of Dental Health, Faculty of Applied Medical Sciences, Albaha University, Albaha, KSA

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المخلص

أهداف البحث: تهدف هذه الدراسة إلى معرفة تأثير أنواع مختلفة من مواد قاعدة أطقم الأسنان الكاملة وكذلك تأثير أنواع الأسنان على أصوات المرضى على المدى القصير.

طرق البحث: أجريت دراسة شبه عشوائية متوازية في عيادة الأسنان بكلية طب الأسنان بجامعة الأزهر – فرع أسيوط، على مجموعة من المرضى خلال ١٠ أسابيع من عام ٢٠١٥. وتم تقسيم ال ٥٠ مريضاً الذين تم اختيارهم إلى مجموعتين. المجموعة الأولى فيها ٣٠ مريضاً والمجموعة الثانية فيها ٢٠ مريضاً. تم تقسيم المجموعة الأولى من المرضى إلى ٣ مجموعات صغيرة والمجموعة الثانية إلى مجموعتين صغيرتين. تم جمع البيانات من المجموعات الخمس عن طريق استبانة للخصائص الديموغرافية واستمارة لقياس صوتيات المرضى. وتم تحليل البيانات بالكمبيوتر بواسطة الحزمة الإحصائية للعلوم الاجتماعية.

النتائج: أظهرت النتائج أن مستويات الصوت كانت أفضل لدى المجموعة التي استخدمت فيها قاعدة معدنية تحتوي على كروم كوبلت مقارنة بالمجموعات الأخرى، بينما أظهرت النتائج أيضاً أن مستويات الصوت لدى المرضى الذين لديهم أسناناً مصنوعة من مادة البروسيلين أفضل من الذين لديهم أسناناً مصنوعة من الأكرليك.

الاستنتاجات: تتأثر أصوات المرضى بالمادة المصنوعة منها قاعدة طقم الأسنان وكذلك المادة المصنوع منها السن نفسه. وأن استخدام الكروم كوبلت لقاعدة الطقم والبروسيلين للأسنان يعطي أفضل الأصوات للمرضى.

الكلمات المفتاحية: أصوات المرضى؛ أطقم أسنان كاملة؛ نوع السن؛ مرضى بدون أسنان؛ البروسيلين

Abstract

Objective: This study aimed to identify the effect of various types of complete dentures, base materials, and teeth types on patients' short-term phonetics.

Methods: A quasi-parallel study was conducted at the dental clinic, Faculty of Dentistry at Al-Azhar University-Assiut Branch in Egypt. Fifty healthy participants with complete dentures were enrolled in the study. The enrolled patients were grouped into two main batches: three groups in batch one and two groups in batch two. The three groups in the first batch received three different denture base materials (flexible acrylic resin, heat cure acrylic resin, and chrome cobalt metallic base). The two groups in batch two received different types of teeth (acrylic and porcelain teeth). The five groups completed a questionnaire composed of items pertaining to demographic characteristics, and the researcher obtained data about phonetics.

Results: The sound level was significantly higher in the group of dentures constructed of chrome cobalt metallic base in comparison to the other materials. Additionally, the sound level in porcelain teeth was significantly higher than that in acrylic teeth. The material used to construct teeth was one of the major determinants influencing phonetics.

Conclusion: Phonetics is affected by the material used to construct the base of complete dentures and the teeth type. Complete dentures with a chrome cobalt metallic base and porcelain teeth are considered to be superior for improving phonetics.

Keywords: Complete dentures; Edentulous patients; Phonetics; Porcelain; Tooth type

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Corresponding address: Department of Dental Health, Faculty of Applied Medical Sciences, Albaha University, P.O. Box: 7273-Unit No.: 2 Albaha 65536 – 3047, KSA.

E-mail: drkhalidarafa@yahoo.com

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Introduction

Complete dentures affect speech sounds by altering the dimensions and morphology of the oral cavity. Upper incisors and the different thicknesses in different areas of the denture's palatal plate were reported as influencing the dimensions of the oral cavity.¹ The impact of these factors on sounds, the virtual period of distinct sounds in a word, and the phonetic variation in patients with dentures was examined.² Speech making has a major influence on patients' overall satisfaction with dentures. Patients' contentment correlates with the acceptance of dentures.³ The insertion of complete dentures often leads to speech alteration. Although many of the alterations are temporary, they are a source of worry for patients. For dentists, there is a lack of guidelines for designing dentures with the best phonetic success.⁴

During the production of speech sounds, the tongue contacts various portions of the teeth, the alveolar ridge, and the hard and soft palates.⁵ When these structures are covered or replaced by a denture, proprioceptive feedback may be changed. Therefore, phonetics may be affected by the presence of dentures. Most of the prosthodontics literature on phonetics has been concerned with the positioning of artificial teeth and the vertical dimension of occlusion.⁶ Few scientific studies have related the speech changes to the palatal contour of complete dentures.⁵ In addition, there are conflicting data on how denture wearers achieve speech improvement.⁶ Negligence about phonetics in the construction of complete dentures may be attributed to edentulous patients tending to return to their normal speech patterns a few weeks after the insertion of dentures.⁷

Previous studies, which investigated factors influencing speech sound in patients with complete dentures, have mainly been limited to clinical case reports. In addition, more recent clinical studies on the phonetic system were limited because of the absence of control groups, blind assessment, and a poor description of standards for assessing mastication affected by a phonetic system that has shown increases in the occlusal vertical dimension.⁸ During the pronunciation of sibilants "z, s, and ch," teeth come close together but do not touch. Silverman's closest speaking space is used for determining the proper vertical dimension.⁹ Few studies have been conducted concerning the effects of both denture material and teeth on the sound level. Identification of the best type of teeth to maintain the sound level is essential to dentistry. This study seeks the best material for dentures and teeth types. Thus, this study aimed to analyse the effect of different types of materials used to construct complete dentures bases and the types of teeth on short-term phonetics via a computerized speech lab (spectrogram).

Materials and Methods

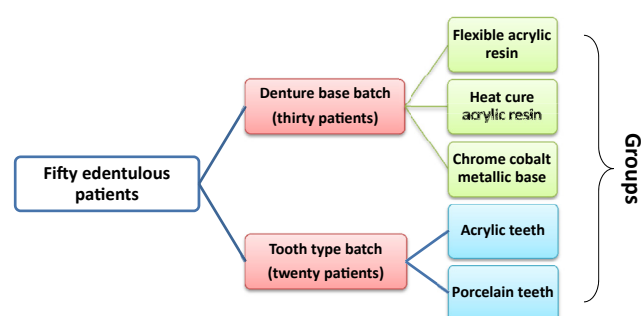
A quasi-parallel design experimental study was conducted. Fifty healthy participants with complete dentures were enrolled in the study at the Dental Clinic, Faculty of Dentistry at Al-Azhar University-Assiut Branch in Egypt during a 10-week period between January and April 2015.

The patients enrolled in this study were male, aged 55 ± 3 years, completely edentulous, with normal occlusion class one, and free from disabilities or chronic conditions, such as

diabetes. All dentures with different materials had the same thickness. Thus, diabetic patients as well as those who were partially edentulous or had neglected oral hygiene were excluded from this study.

The patients enrolled in the study ($n = 50$) were divided into two main batches (three groups in batch one and two groups in batch two) and distributed randomly as ten patients in each group. The three groups in the first batch received three different denture base materials, flexible acrylic resin (group 1), heat cure acrylic resin (group 2), and chrome cobalt metallic base (group 3), for the constructed palatal plate and rouge area of the complete dentures. Another batch (twenty patients) divided into two groups received different types of teeth: acrylic teeth (group 1) and porcelain teeth (group 2).

The flow chart of the study:



The five groups completed a questionnaire composed of items pertaining to demographic characteristics, while the researcher measured speech quality. The evaluation of speech quality was made by measuring patients' phonetics. The patients were connected to a spectrogram and were asked to verbalize Arabic pronunciation letters (ص, ض, غ, ع). The mean of the sound levels was calculated for each patient and subsequently tabulated and analysed. The evaluation was made immediately following denture insertion at three weeks and at ten weeks following the insertion of dentures at a computerized speech lab (spectrogram). This measurement protocol was implemented for two batches. The level of sound in patients was assessed via a spectrogram with complete dentures made from different base materials or from different teeth.

The collected data were then analysed by SPSS version 20. The chi-square test was used to test differences in the demographic characteristics of the two groups. The independent t-test was employed to identify differences between the two groups. All values were tabulated as the average (mean) with standard deviation (SD), whereby p -values less than 0.05 were considered statistically significant.

Results

The fifty patients were homogenous with respect to the demographic characteristics in the two batches. While some

Table 1: Characteristics of the patients (batch 1 and batch 2) that took part in the study.

Batches	Variable		Types of material			<i>p</i> -value
			Heat cure acrylic resin n (%)	Flexible acrylic resin n (%)	Chrome cobalt metallic base n (%)	
Batch 1	Education level	Illiterate	4 (40%)	3 (30%)	5 (50%)	0.45
		Primary	6 (60%)	7 (70%)	5 (50%)	
	Age (mean \pm SD)		56 \pm 2 years	58 \pm 3 years	59 \pm 2 years	0.23
	Variable		Types of material			<i>p</i> -value
			Acrylic teeth n (%)		Porcelain teeth n (%)	
Batch 2	Education level	Illiterate	5 (50%)		4 (40%)	0.26
		Primary	5 (50%)		6 (60%)	
	Age (mean \pm SD)		57 \pm 3years		58 \pm 4 years	0.38

(*) Statistically significant.

differences in the variables, such as in age and education level were noted, they were not statistically significant ($p > 0.05$) (Table 1).

The effects of the constructed palatal plate and rouge area of the complete dentures on patients' sounds were measured in relation to all types of material used at three points: at insertion, at three weeks, and at ten weeks post-insertion. The sound was significantly higher in the group of dentures constructed from chrome cobalt metallic base than in the dentures constructed from flexible acrylic resin or heat cure acrylic resin. Using flexible acrylic resin or a chrome cobalt metallic base significantly improved the level of sound at the tenth week (Table 2).

The results showed that the sound levels in porcelain teeth were significantly higher than in acrylic teeth at insertion, at three weeks, and at ten weeks post-insertion. At insertion, the sound level was 2.5 L_k for porcelain teeth and 1.8 L_k for acrylic teeth. It was also shown that using porcelain teeth improved the sound level at the tenth week post-insertion (Table 3).

Discussion

There are many factors that affect voice, including the dimensions, locations and fabrication materials of the teeth as well as plaque. Sound is formed as a result of the functional relations of various formations of the voice organ. The second most important component controlling sound waves

is acoustic speech.¹⁰ This study assessed the effect of base materials and teeth types on the sound level.

The findings revealed the superiority of chrome cobalt metallic base dentures over heat cure acrylic resin and flexible acrylic resin dentures. That is, the study showed that the levels of sound were significantly higher among patients who received chrome cobalt metallic base dentures. These results confirm those of previous studies. For example, a study undertaken by Hala M. Abdalhameed et al. concluded that with proper denture construction, the palatine rugae plays an important role in speech pronunciation, as there should be some anatomical landmarks, which the tongue can recognize to produce particular sounds. This result can be found with metallic base plates.¹¹ It is necessary to make the base of prostheses as thin as possible to improve sound pronunciation,¹² which is best achieved when using metallic base plates in denture construction. The study also showed that the level of sound measured by the spectrogram was superior in patients who received porcelain teeth rather than acrylic teeth. According to the results, the best material was a chrome cobalt metallic base, followed by flexible acrylic resin.

During the production of speech sounds, the tongue contacts various portions of the teeth, the alveolar ridge, and the hard and soft palates. In addition, phonetics may be affected by the presence of dentures. A number of sounds are affected by the tooth position, flange thickness, lip support, and material used to construct the base of complete dentures. Phonetics improved as the patients adapted to the new shape

Table 2: The effect of the constructed palatal plate and rouge area on the level of the sound of the complete dentures using three types of materials.

Types of materials	Sound levels (L _k) at different times						<i>p</i> -value of timeline evaluation
	At insertion		After 3 weeks		After 10 weeks		
	Mean	SD	Mean	SD	Mean	SD	
Heat cure acrylic resin	1.6	0.03	1.7	0.03	1.8	0.03	0.09
Flexible acrylic resin	2	0.04	2.1	0.04	2.3*	0.04	0.03*
Chrome cobalt metallic base	3	0.06	3.4	0.07	3.8*	0.07	0.012*
<i>p</i> -value	0.02*		0.03*		0.01*		

(*) Statistically significant.

Table 3: The effect on the level of the sound of the different teeth types (acrylic and porcelain).

Types of teeth	Sound levels (L_k) at different times						p -value of timeline evaluation
	At insertion		After 3 weeks		After 10 weeks		
	Mean	SD	Mean	SD	Mean	SD	
Acrylic teeth	1.8	0.03	1.9	0.035	2	0.04	0.07
Porcelain teeth	2.5	0.05	2.8*	0.046	3*	0.06	0.03*
p -value	0.04*		0.02*		0.01*		

(*) statistically significant.

of the dentures. The sound level increased at three weeks and at ten weeks after insertion of dentures as measured at a computerized speech lab (spectrogram). Using flexible acrylic resin, chrome cobalt metallic base materials or porcelain teeth types has a positive impact on short-term phonetics. These findings are in contrast to the findings from a Turkish study that evaluated the articulation of Turkish phonemes after application of removable partial dentures. The Turkish study showed that problems in articulation occurred post-insertion for a removable partial denture, while for other study subjects, a significant amelioration was observed after the insertion of a removable partial denture. In general, problems in articulation of evaluated phonemes were resolved after one week of partial denture use.¹³

The strengths of this study include comparing two techniques to improve the sound levels for complete dentures. The main study limitations include a lack of randomization and controls and a limited area of recruitment (Dental Clinic, Faculty of Dentistry at Al-Azhar University-Assiut Branch in Egypt). Therefore, the generalizability the findings of this study are limited. Thus, it is recommended that fully randomized and properly controlled studies, conducted on a larger sample recruited from the entire country, are to be undertaken in the future. Other limitations of this study include using only Arabic letters and not considering lingual-alveolar sound during the evaluation of the sound level.

Conclusion

It is concluded that words spoken by edentulous patients were related to words spoken during the different stages of denture wear. An analysis revealed that a number of sounds were affected by the material used to construct the base of the complete dentures and by the type of teeth. Chrome cobalt metallic base and porcelain teeth are superior measures for improving the sound level. However, it is difficult to know if the sound level will improve as the patient adapts to the new complete dentures.

Author's contribution

KAA is the main investigator of this work. He designed, drafted and prepared all of the related work.

Ethical approval

This study was approved by the Dental Health Department of the Faculty of Applied Medical Sciences, Albaha University. and all participants signed consent forms prior to

the study. The right of the participants to withdraw at any time was explained and preserved during the study. The study was registered in the International Standard Randomised Controlled Trials Number (ISRCTN) registry with study ID **ISRCTN10251727**.

Conflict of interest

I declare that this study is my own work and the manuscript has not been submitted to any other journal. I also declare that I have no conflict of interest related to this study.

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