



## Effect of Different Denture Base Materials on the Masticatory Muscle Performance in Patients Wearing Single Maxillary Complete Denture: A Cross-over Study

Doaa A. Rostom<sup>1\*</sup>, Ahmed E. Fayyad<sup>2</sup>, Aliaa A. Tawfeek<sup>3</sup>

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azhardentj@azhar.edu.eg

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### ABSTRACT

**Purpose:** The aim of the research was to evaluate the masticatory muscle performance with different resilient denture base materials in maxillary single denture. **Material and methods:** Six patients were included in this cross over study. In the first stage of the study, the patients were instructed to use the denture (PMMA denture base) for 1 month and the masticatory muscle activity was assessed in the second and fourth weeks after delivery. A wash out period of two weeks was applied in this study to eliminate the effect of the previous denture then the denture material was relined to soft liner, then replaced with brefflex flexible material. For each type of denture base relining material, EMG was recorded after 2 weeks form day of denture insertion (adjustment phase) then EMG was recorded after 4 weeks after complete muscles adaptation (adaptation phase). **Results:** Comparison between three types of denture bases was performed by one way ANOVA test which revealed significant difference between them regarding duration and amplitude of both masseter and temporalis after 2 weeks and after 4 weeks as  $P < 0.05$ . **Conclusion:** This in-vivo study, which shows that rehabilitation of correct masticatory muscle function, improved with the proper use of denture base material and which leads to improvement in the patient's quality of life.

### INTRODUCTION

Single maxillary denture is not an uncommon situation yet challenging condition. The main problem of single denture is the great forces exerted by the opposing dentition during function that could lead to accelerated bone resorption. As a result, the residual ridge will be unable to withstand the applied occlusal forces. Using dental implants distribute the occlusal forces between the implants and the residual ridge

### KEYWORDS

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1. Lecturer in Prosthodontics Department, Faculty of Dentistry, Cairo University.
2. Assistant Professor in Prosthodontics Department, Faculty of Dentistry, Cairo University, Cairo, Egypt.
3. Lecturer in Clinical Neurophysiology Unit, Faculty of Medicine, Cairo University, Cairo, Egypt.

\* Corresponding author email: Doaa.heshmat@dentistry.cu.edu.eg

thus saving the ridge from accelerated resorption<sup>(1)</sup>. Unfortunately dental implants are not indicated in all cases due to anatomical, medical or financial constraints. In such cases, using different flexible denture base material rather than the conventional polymethyl methacrylate denture bases acts as a cushion that reduces the forces on the residual ridge and so reduces the rate of bone resorption.

One of the changes that happens after teeth loss is the change in the biting force and the masticatory efficiency some authors have observed substantial improvement of masticatory performance with new complete dentures after periods of 1 month up to a year<sup>(2)</sup> others observed no improvement at all or even decrease in the masticatory performance, the deterioration of masticatory performance could be compensated by prolonged chewing time<sup>(3,4)</sup>.

The effect of denture relining on the masticatory muscle performance should be assessed, few articles have satisfactorily reported on how masticatory performance and muscle activities are affected by the use of denture soft materials. And almost no previous studies compared the effect of hard acrylic, soft acrylic denture based liners and flexible acrylic on muscle function<sup>(5,6)</sup>.

Electromyography (EMG) activities for masseter and temporalis muscles in relation to the resilient denture base materials is unclear up till now. After complete loss of natural teeth, the masticatory cycle amplitude, efficiency and the masticatory force are altered and reduced in comparison with dentate patient<sup>(7,8)</sup>. Many factors play a role in masticatory muscle activity, the opening and closing velocity of masticatory muscle and the muscle adaptation to the new denture, the patient age, sex, number of years of being edentulous, oral conditions, denture mobility, patients old denture experience and the degree of denture adaptation<sup>(9,10)</sup>.

The aim of this research was to evaluate the masticatory muscle performance with different resilient denture base materials in maxillary single denture.

## MATERIAL AND METHODOS

Six patients were included and selected from the outpatient clinic of Faculty of Dentistry, Cairo University, having maxillary completely edentulous arch and mandibular complete set of teeth. Patient's history and clinical examination were checked as usual. All participants' age range were from 40 to 60 year. A new conventional maxillary complete denture was delivered to the patients in the first stage of the study after occlusal equilibration with the opposing dentition (Fig.1). In the first stage of the study, the patients were instructed to use the denture for 1 month and the masticatory muscle activity was assessed in the second and fourth weeks after delivery.

A wash out period of two weeks was applied in this study to eliminate the effect of the previous denture after taking the approval from the included volunteers. In the second stage of the study and after the washout period, the same complete denture was prepared to be relined with Acrostone soft liner (Bredent GmbH and CO.KG) by chair side relining, then breflex flexible material (Bredent.Flex2nd Edition Pink Veined) was used in the third stage of this study where the denture base was relined, final impression was made by silicon rubber material (Zetaplus). The impression was poured into a cast for rebasing in the lab through injection breflex material.

For each type of denture base relining material, EMG was recorded after 2 weeks form day of denture insertion (adjustment phase) then EMG was recorded after 4 weeks after complete muscles adaptation (adaptation phase)

The masseter and anterior temporalis muscles on both sides were thoroughly examined, electrode placed over the skin after cleaning with ethanol (Fig.2). During procedure, the patient sat with their head unsupported and asked to maintain a natural upright position with Frankfort horizontal plane

nearly parallel to ground. During test performance, the subjects were verbally encouraged to perform at their best. The patient was instructed to bite forcefully in maximum intercuspation. Three bite force recordings were carried out at 30 second intervals for each muscle testing. A computerized system was used for recording and analysis of electromyographic data. Each of the three recordings was analyzed for peak amplitude and duration of the longest wave and was subjected to statistical analysis. Following completion of EMG recordings, the maxillary and mandibular dentures were relined with silicone based denture liner.



Figure (1): maxillary single denture



Figure (2): masticatory muscle efficiency evaluation

## RESULTS

Statistical analysis performed with SPSS 20 Statistical Package for Social Science, IBM, USA. Graph Pad Prism and Microsoft Excel 2016 (Microsoft Co-operation, USA) (statistical Package for Social Science, IBM, USA. Graph Pad Technologies, USA. Microsoft Co-operation, USA.) With significant level set at  $P \leq 0.05$ . Data were presented as means and standard deviation (SD) values.

In this in-vivo study, the mean and standard deviation of duration and amplitude of temporalis and masseter muscles in PMMA denture, denture with soft liner and breflex are during the first follow up period (after 2 weeks) and second follow up period (after 4 weeks) are presented in tables (1,2) and fig. (1, 2) respectively.

Comparison between three types of denture bases was performed by one way ANOVA test which revealed significant difference between them regarding duration and amplitude of both masseter & temporalis after 2 weeks and after 4 weeks as  $P < 0.05$  as presented in tables (1,2).

ONE-WAY ANOVA test was followed by Tukey's Post Hoc test for multiple comparisons which revealed significant difference in means with different superscript letters ( $P < 0.05$ ), while revealed insignificant difference in means with the same superscript letters ( $P > 0.05$ ) as presented in tables (1,2).

Comparison between 2 follow up readings (between after 2 weeks and after 4 weeks) was performed by Paired t-test which revealed insignificant difference ( $P > 0.05$ ) in all readings of masseter muscle except amplitude of denture with soft line and duration and amplitude of breflex denture, while in temporalis muscle it revealed insignificant difference in all readings ( $P < 0.05$ ) except amplitude of denture with soft liner and duration of breflex denture as presented in tables (3, 4) and fig (3, 4)

**Table (1): Comparison between EMG readings in 2 weeks & after 4 weeks in masseter muscle regarding duration & amplitude in three different dentures**

		Masseter				P value
		After 2 weeks		After 4 weeks		
		M	SD	M	SD	
PMMA denture	Duration	10.5	1.3	10.5	1.5	0.99
	Amplitude	625	53.5	625	53.6	0.99
Denture with soft liner	Duration	7.625	1.77	6.65	1.12	0.13
	Amplitude	296.25	31.25	441.5	101.75	0.004*
Breflex denture	Duration	8.1	0.75	8.925	0.3	0.01*
	Amplitude	500.75	25.75	443.75	57.25	0.03*

M; mean SD; Standard deviation \*Significant difference , P value; probability level

**Table (2): Comparison between EMG reading after 2 weeks & after 4 weeks in temporalis muscle regarding duration & amplitude in three different dentures:**

		Temporalis				P value
		After 2 weeks		After 4 weeks		
		M	SD	M	SD	
PMMA denture	Duration	10.6	2.2	10.6	2.4	0.99
	Amplitude	569	66.5	569	66.5	0.99
Denture with soft liner	Duration	7.87	2.275	6.65	1.125	0.14
	Amplitude	396.25	35	441.5	41.75	0.01*
Breflex denture	Duration	7.82	0.85	8.92	0.5	0.001 *
	Amplitude	452	37	468.75	42.25	0.3

M; mean SD; Standard deviation P value; probability level \*Significant difference

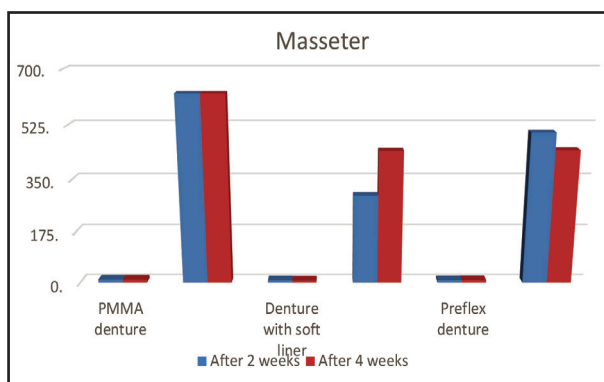


Figure (3): Comparison between reading after 2 weeks & after 4 weeks in Masseter

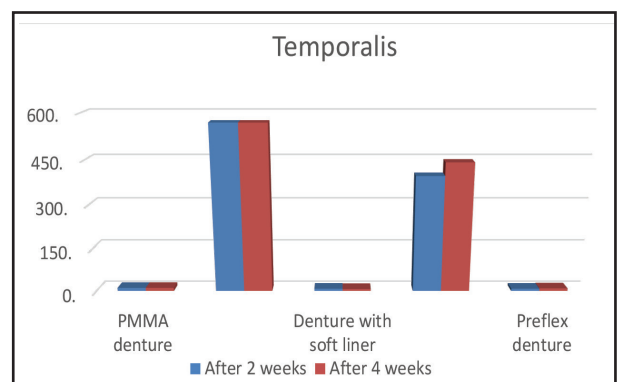


Figure (4): Comparison between reading after 2 weeks & after 4 weeks in Temporalis

## DISCUSSION

Generally, a reduction in masticatory efficiency with an increase in muscle activity is reported after the loss of one or more tooth and consequently by the loss of all teeth<sup>(9, 12)</sup>.

The rehabilitation of correct masticatory muscle function when constructing a complete denture is essential to improve the patient's quality of life<sup>(11)</sup>. This study compared the masticatory muscle activity of patients wearing complete maxillary denture with three different denture base materials (conventional heat cured acrylic resin, acrylic resin denture base relined with acrostone soft liner and acrylic resin denture base relined with breflex material).

It is reported that there is a higher level of electrical activity of the masticatory muscle during chewing of hard food. This finding could be also related to the type of denture base material, either hard or soft, where using the conventional hard denture base may lead to higher muscle activity, while using flexible denture base material may lead to dissipation of part of the masticatory forces within the denture base, which acts as cushion and so reducing the electrical muscle activity<sup>(13)</sup>.

The comparison between the three types of denture base materials in this study revealed significant difference between them regarding muscle activity of both masseter and temporalis muscles after 2 and 4 weeks from the denture use with a higher level for the hard acrylic group.

As mentioned before, this might be due to dissipation of the masticatory forces within the flexible denture base. The two relined denture base groups (breflex and acrostone soft liner) showed insignificant difference between them, this may be due to the inherent resiliency of the two types of the relining materials, which is nearly the same in the first month of use. This results may change if the follow up is extended to a longer period which might show change in the material behavior which might affect the masticatory muscle activity.

## CONCLUSION

This in-vivo study shows that rehabilitation of masticatory muscle function is improved with the proper denture base material which leads to improvement in the patient's quality of life

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