



## Effect of Different Denture Base Material on Electromyographic Activity in Maxillary Single Denture Wearers

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### ABSTRACT

**Aim of study:** was to evaluate and compare the effect of three different denture base material (heat cured acrylic resin, cast metal base and thermoplastic resin) on electromyographic activity of masseter and temporalis muscles in maxillary single denture wearers. **Material and methods:** Ten completely maxillary edentulous patients were selected with ages ranged from 55-60 years. All patients had received heat cured acrylic resin single maxillary complete denture (Group I) then replacing the denture base through rebasing procedures by cobalt chromium (Co-Cr) (Group II) then thermoplastic resin material (Group III). All patients were instructed to use their resin dentures for equal periods of three months when EMG records of muscles of mastication (masseter and temporalis) were obtained at insertion then patient recalled after one month and at the end of three months, period of two week interval was left between each group as a washing period. **Results:** The results of this study showed that there were a significant differences between them, as the thermoplastic resin (group III) was the best followed by cobalt chromium denture (group II) then heat cured acrylic resin denture base (group I). **Conclusion:** EMG activity affected by maxillary denture base material as the lesser effort of masticatory muscles was done by using thermoplastic resin denture base rather than Co-Cr or acrylic resin denture base.

### INTRODUCTION

Single complete denture construction against natural dentition is a very challenging task for the dentist due to certain many problems like frequent prosthesis fracture, dislodgement, difficulty to obtain occlusal balance, and achieve satisfactory esthetics due to fixed position of the natural teeth. After the loss of the maxillary teeth and in the absence of the prosthetic treatment, the opposing dentition tends to tilt and extrude

### KEYWORDS

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compared to a normal relationship which results in an unfavorable force distribution.<sup>(1,2)</sup>

Poly methyl methacrylate resin (PMMA) is the dominant material for the fabrication of denture bases another denture base material cobalt chrome alloys (CO-Cr) and thermoplastic resin material were introduced to dentistry as a useful alternative to (PMMA) in special circumstances where higher flexibility and higher impact strength is required.<sup>(3,4,5)</sup>

Electromyographic activity (EMG) evaluation is an objective method that provides the masticatory muscle behavior in many situations during the function. Therefore, this study was designed to evaluate the effect of three different denture bases material on EMG in maxillary single denture wearers.<sup>(6)</sup>

## MATERIAL AND METHODS

Ten completely maxillary edentulous patients were selected. Patients' ages ranged from 55-60 years. All patients were free from any temporomandibular joint disorder or parafunctional habits and they had no previous experience in wearing dentures to eliminate the expected adaptation of the muscle and All patients accepted this dental treatment and informed about the steps of this study and signed a written consent with the Research Ethics Committee (REC) approval.

All patients had complete missing of maxillary teeth and the opposing mandibular arch had full set of teeth. The ten patients were received heat cured acrylic resin single maxillary complete denture then replacing the denture base through rebasing procedures by cobalt chromium (Co-Cr) then thermoplastic resin material. The denture base material used in this study were divided into three groups of denture base materials; Group I (conventional heat cured acrylic resin), group II (Co-Cr) and group III (thermoplastic resin).

Patient history and clinical examination for medical, dental, extra oral, intra oral and radiographic examination were carried out for each patient.

A horse-shoe articulating paper was attached to the lower convex surface of the metal U shaped occlusal template (occlusal bite plate) and occlusal analysis for the lower cast was made to detect any occlusal disharmony. The interfering cusps were identified and grinded to get an acceptable occlusal plane. (Fig. 1)

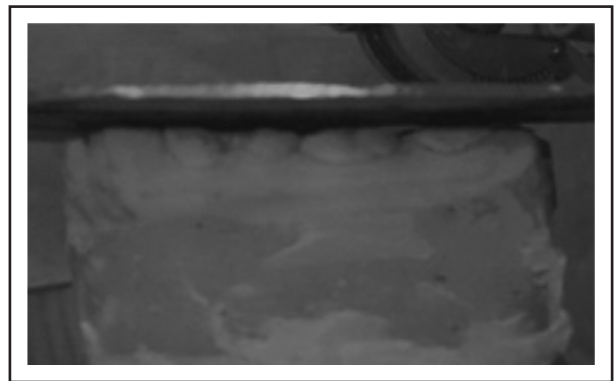


Fig. (1): Occlusal template with articulating paper on the lower cast.

Regarding group I, Heat cured acrylic resin denture was constructed according to conventional steps, flasking, wax elimination, packing, curing, finishing and polishing. The finished denture was checked for proper extension, retention and stability intra-orally. The patient was given a proper program for denture insertion and oral hygiene measures

As regarding group II, all patients received heat cured acrylic resin denture base were replacing the denture base by rebasing procedures through occlusal index to cobalt chromium (Co-Cr) (Fig.2). The denture teeth were cut from the denture base with a bur and seated in their indentations. Wax pattern for maxillary complete denture base was built then spruing, casting, metal try-in, teeth try-in, laboratory remounting, denture processing and denture delivery were made.

For group III, Thermoplastic resin denture base used was polyamide resin (bredent). The teeth were cut from the metallic base and placed in the index then wax base is made on the upper cast then teeth cemented to it and invested in a special flask for thermoplastic resin.



Fig. (2): Occlusal index for single maxillary denture on the articulator.

### Electromyographic activity evaluation

Surface electromyographic records were obtained from both right and left masseter and temporalis muscles by using an electromyographic device (Nemus II). The electrode placement was determined by instructing the patient for chewing on his denture teeth at upright position thus creating a region of facial muscle contraction, and alcohol swab was used for cleaning skin to improve conductivity. The recordings were obtained during chewing 1 cm<sup>3</sup> of banana and carrot which represents soft and hard food respectively.

The masseter muscle electrodes were placed 1 cm behind the palpated anterior border, for the anterior temporalis muscle electrodes were placed over its anterior portion and a ground electrode was connected to the patient's forehead and electrodes were fixed by adhesive tapes.

All patients instructed to use their resin dentures for equal periods of three months when EMG records of muscles of mastication (masseter and temporalis) obtained at insertion then patient recalled after one month and at the end of three months, period of one week interval was left between each group as a washing period. Statistical analysis was carried out for measuring the activity of anterior masseter and temporalis muscles.

### Statistical analysis

All measurements were recorded and tabulated. Statistical analysis of the data was performed with SPSS 15 (Statistical package for Scientific Studies) for Windows.

Data analysis was performed, one-way analysis of variance ANOVA was used for comparing means of the three different types of denture bases. The significance level was set at P-value less than 0.05.

### RESULTS

#### Comparison between muscle activities of the three groups:

At insertion time, after one month and after three months during hard and soft food chewing of masseter and temporalis muscle activity, it was found that the highest mean value recorded for group I hard and soft food followed by group II hard and soft food while the lowest mean value was recorded for group III hard and soft food. The difference between groups was statistically significant difference (P-value < 0.05), as listed in (Table 1,2).

### DISCUSSION

The single maxillary denture is a complex prosthesis that requires a complete understanding of the basics of denture occlusion. In the present study maxillary single denture was selected rather than mandibular one because the upper single denture can be functionally successful as a large denture-bearing area offering stability and provide adequate resistance to occlusal forces of lower natural teeth, it provides comfort, retention, esthetic, more common and more favorable than mandibular single dentures. Large tuberosities provide definite vertical posterior surface which can resist anterior displacement. Also the tongue can develop habits for even more added stability.<sup>(7,8)</sup>

Three different denture base material were used in this study, heat cured acrylic resin denture base (group I), cobalt chromium denture base (group II)

**Table (1):** Comparison between conventional heat cure acrylic resin “ Group I”, Co-Cr “Group II” and thermoplastic resin denture bases “Group III” regarding masseter muscle for hard and soft food chewing at insertion, after one month and three months.

				Group I	Group II	Group III	P-value
Masseter muscle	At insertion	Hard food	M	512.78	271.49	245.16	<0.0001*
			SD	154.61	24.54	20.65	
		Soft food	M	460.18	169.78	143.45	<0.0001*
			SD	140.36	6.87	4.42	
	After one month	Hard food	M	231.97	153.12	121.96	<0.0001*
			SD	73.34	21.12	10.69	
		Soft food	M	205.74	125.31	108.62	<0.0001*
			SD	63.81	6.12	5.59	
	After three months	Hard food	M	212.36	130.57	109.35	<0.0001*
			SD	71.84	11.36	7.89	
		Soft food	M	193.21	110.64	91.31	<0.0001*
			SD	62.96	5.98	5.01	

M: Mean value, SD: Standard Deviation, P: Probability level, \*: significant difference.

**Table (2):** Comparison between conventional heat cure acrylic resin “ Group I”, Co-Cr “Group II” and thermoplastic resin denture bases “Group III” regarding temporalis muscle for hard and soft food chewing at insertion, after one month and three months.

				Group I	Group II	Group III	P-value
Temporalis muscle	At insertion	Hard food	M	498.15	262.96	243.63	<0.0001*
			SD	141.38	18.19	16.53	
		Soft food	M	510.38	220.65	200.91	<0.0001*
			SD	143.63	33.75	30.82	
	After one month	Hard food	M	242.32	149.25	124.23	<0.0001*
			SD	86.84	15.42	6.24	
		Soft food	M	221.51	120.22	105.82	<0.0001*
			SD	67.35	8.49	5.65	
	After three months	Hard food	M	212.36	130.57	109.35	<0.0001*
			SD	71.84	11.36	7.89	
		Soft food	M	193.21	110.64	91.31	<0.0001*
			SD	62.96	5.98	5.01	

M: Mean value, SD: Standard Deviation, P: Probability level, \*: significant difference.

and thermoplastic resin denture base (group III). The heat cured conventional acrylic resin was the most popular denture base material due to its various advantages, including low cost, biocompatibility, ease of processing, stability in the oral environment, and acceptable aesthetics. However, it is not considered an ideal denture base material because of its inferior physical and mechanical properties.<sup>(9)</sup>

Metal denture base was used for more biocompatibility and retentive compared to heat cure acrylic resin dentures due to hypoallergic effect with healthy appearing supporting tissues, higher dimensional stability, rigidity, lighter in weight and could be casted in thinner section than acrylic dentures.<sup>(10)</sup>

Occlusal adjustment for the lower teeth was made using a metal U shaped occlusal template to create an acceptable occlusal plane necessary for maxillary denture stability, satisfactory esthetics, phonetics and masticatory functions.<sup>(11)</sup>

Maxillary denture base was exchanged by another type of denture base material rather than construction of new denture to decrease expenses and time consumed so replacing the entire denture base material on an existing prosthesis without changing the dental arch and the occlusal relationship of the teeth in order to standardize the common factors.<sup>(12)</sup>

Measurements of muscle activity were recorded at insertion for study the effect of time on EMG activities of the masseter and temporalis muscles were evaluated after one month and three months from denture delivery to allow denture settling, adaptation and muscle accommodation. Patients have a washing period about one week when rebasing of denture base by another type so giving the tissues and bone a chance to relax from the pressure of the denture in order to be ready to receive the new denture base.<sup>(13,14)</sup>

In the present study, different denture base material resulted in changes of electrical muscle activities. The results of this study were showed that EMG activity decreased by time throughout the follow up

period of patients. Such finding might be due to the improving patient acceptance and adaptation to the prosthesis and better neuromuscular control that the patient naturally acquired by time. This finding was agreed with another study that found, the reduction in masticatory muscle activity could related to the prosthesis adaptation.<sup>(15,16)</sup>

The current study showed that there was a positive response of muscle activity to thermoplastic resin maxillary denture base during chewing soft and hard food. The real decrease in muscle activity indicated improvement of the functional state of the masticatory system.<sup>(17)</sup>

The decrease in muscle activity can be correlated to the improvement in retention and stability of the dentures achieved by dimensional accuracy and adaptation of the thermoplastic resin denture base rather than metal denture base which subjected to dimensional changes due to has high coefficient of thermal expansion of metal and conventional heat cured acrylic resin denture base due to its high polymerization shrinkage.<sup>(18)</sup>

The successful function of a complete denture is dependent upon its accuracy of fit. Dimensional inaccuracies as a result of polymerization shrinkage of heat cured acrylic denture base, have been demonstrated to cause clinical instability of the resulting denture base against the denture bearing tissues. This may lead to pain during function as result of uneven loading of the denture base. Also it was found that, there is a correlation between masticatory performance and complete denture quality.<sup>(19,20)</sup>

## CONCLUSION

Within the limitations of this study, it can be concluded that:

- EMG activity affected by maxillary denture base material as the lesser effort of masticatory muscles was done by using thermoplastic resin denture base rather than Co-Cr or acrylic resin denture base .

- Thermoplastic resin and cobalt chromium dentures are excellent alternative treatment modalities to acrylic resin dentures.

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