

EFFECT OF DIFFERENT COMPLETE DENTURES BASE MATERIALS ON MUSCULAR ACTIVITY

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ABSTRACT

Aim: The purpose of this study was to examine changes in relative electromyographic (EMG) activities of temporal and masseter muscles after relining the dentures with soft, hard and conventional heat cured based denture liners.

Materials and Methods: Conventional complete dentures were fabricated for 30 edentulous patients. They were divided into three groups. Group I including patients received denture relined with soft liner. Group II including patients received denture relined with hard liner and Group III including patients received dentures relined with conventional heat cured relining material. Electromyography of the masseter and temporalis muscle was recorded during eating carrot as hard food and banana as soft one. The records were measured after one, three and six months. Data was analyzed using Statistical ANOVA test to compare between muscle activities of the three groups. Duncan's test was used for pair-wise comparisons to determine the differences between means.

Results: Complete denture relined with soft liner showed significant difference in masseter and temporalis muscles activities as compared with the two other groups.

Conclusion: Complete denture relined with soft liner show better effect on masseter and temporalis muscles activity and patient satisfaction.

INTRODUCTION

Some complete denture wearers find mastication difficult because of presence of atrophic alveolar ridges. Consequently, dentists may encounter such patients more frequently.

One of the most important factors of the prosthetic treatment with complete denture is its retention during rest and function; otherwise, it won't be

likely effective during function nor physiologically accepted.⁽¹⁾

The denture bearing area become reduced in extremely resorbed ridge and the mucosa overlying it decrease in thickness and lacks elasticity, furthermore, the ridge is unable to support occlusal forces where it can be overcome with the use of either implants or resilient liners, as such patients find difficulties while mastication.⁽²⁾

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Relining denture prosthesis improves stability and retention of the prosthesis in cases in which any changes underlying tissues led to ill-fitting and lack of support of the denture base. ⁽³⁾

Using relining materials over the denture base reduce the load on the supporting tissues as they absorb energy, the load are distributed evenly over the entire denture bearing area thus preventing stress concentration over the localized area. Several researches reported that these materials improve denture stability, patients comfort and absorb impacts and masticatory load distribution, thus enhance functional activities. ⁽⁴⁻⁷⁾

Soft liners have been a valuable assist for dentists because of their visco-elastic properties. The material has the advantage of compress and distribute the stresses on the denture bearing tissues when a load is applied, and recover when the load is released, and it maintain the desired resiliency over time. ⁽⁸⁻⁹⁾

Denture liners are classified as soft or hard, acrylic resin based or silicone based, and chemically or thermally polymerized and is indicated for temporary and permanent use. They have different clinical effect as they have different mechanical properties. The effect of denture relining on stomatognathic system should be assessed in addition to the concerns regarding patient satisfaction. ⁽¹⁰⁻¹¹⁾

Electromyography (EMG) is defined as the graphic recording of the electrical potential of muscle. Surface electromyography of masticatory muscles can be an effective method of measuring muscular activity, stability and comfort during static and dynamic tasks ⁽¹²⁻¹³⁾. There have been several reports regarding the physical properties and contamination of soft liners ⁽¹⁴⁻¹⁵⁾.

There have been few studies on the effects of soft denture liners on masticatory function. However; none of the reports has satisfactorily clarified how

masticatory performance and muscle activities are affected by the use of these soft materials

The purpose of this study was to examine changes in relative EMG activities of temporal and masseter muscles after relining the dentures with three permanent relining materials and evaluate patient's satisfaction.

MATERIALS AND METHODS:

Thirty completely edentulous patients were selected from the outpatient clinic of prosthodontics department, faculty of oral and dental medicine, Cairo University. All patients were ranged from 55-70 years, free from any systemic or skeletal muscle disorders, with firm mucosa of moderate thickness and free from any signs of inflammation covering the ridges.

They were divided *into three equal groups*:

Group I: Ten patients with dentures relined with chair side soft relining material (Promedica, Domagkstr. Neumunster, Germany).

Group II: Ten patients with dentures relined with chair side hard relining material (Acrostone hard relining material. Acrostone dental manufacture, Cairo, Egypt)

Group III: Ten patients with dentures relined with conventional heat cured relining material

Fabrication of New Dentures:

Primary impression was made using Stock edentulous trays (DentcraftSto-K TRAY; Yoshida, Tokyo, Japan) and irreversible hydrocolloid impression material (Cavex CA37: Cavex Holland BV, Holland) were used.

Border molding procedures were carried out using custom trays fabricated on study casts and stick modeling compound (Harvard, Harvard dental. Berlin, Germany)

Zinc oxide eugenol impression paste (Cavex

outline impression eugenol free, cavex Holland, haarlem, Netherlands.) was used for making final impressions.

The jaw relation was recorded using occlusal rims and an interocclusal registration paste (superbite; Harry J. Bosworth Co., Skokie, IL). Try-in was done and patient's feedback and acceptance of the trial dentures were obtained. Complete dentures were fabricated using heat polymerized acrylic resin. The dentures were inserted after processing. A thorough clinical examination of the denture for proper extension, adequate retention and stability and occlusion in maximum intercuspation was done, if premature contacts were observed on the path of closure, occlusal adjustments were made by using articulating paper (Horseshoe/Full Arch, red/blue articulating film; Ardent, Inc., Ossining, NY, USA).

Muscular activity evaluation:

The muscular evaluation was performed in each phase during the study. Muscular activity, represented by the root mean square value (RMS), was evaluated by using a digital electromyogram (EMG) (Nihon Kohden, America, INC. U.S.A.).

The position of the surface electrodes on the anterior temporalis and the masseter muscles were marked on the patient's face by selecting the maximum bulging of the muscle fibers while the patient eating carrot and then eating banana fruit as hard and soft food.

During the EMG recording appointments, the cases were seated in an upright relaxed position with their head being in the same line with their body. Before attaching the surface electrodes, the participant skin was cleaned with alcohol at the corresponding areas. Furthermore, the forehead was cleaned where the ground electrode was placed.

The inner sides of the electrodes were filled with Ten20 conductive EEG paste (Weaver and Co. Aurora, U.S.A.) and were fixed on the participant's

skin using an adhesive tape on the anterior temporalis muscle and on the masseter muscle .

During procedure, the patient sat with their head unsupported and asked to maintain a natural erect position with Frankfort horizontal plane nearly parallel to ground. The patient was instructed to chew carrot for 30 seconds and then banana for another 30 seconds. 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 different based denture liner.

Denture Liners:

For group I: Relining the Dentures Using soft chair side Denture Liners for the maxillary and mandibular dentures using direct relining technique, as recommended by the manufacturer. The maxillary and mandibular dentures were relined separately using intercuspal position as guide. Borders and tissue surface of the denture were trimmed by 1.5-2 mm except in the region of canine and first molar to act as vertical stops ensuring proper placement of dentures. Once trimmed, the degreasing was done by means of pure medical alcohol and allowed to dry. Later primer liquid supplied by the manufacturer was applied uniformly and dried for 2 minutes. Relining material was applied directly from the cartridge on to the prepared denture base, uniformly maintaining a thickness of 2mm over the tissue surface and borders. It was then placed in patient's mouth and functional molding was accomplished. Patient was asked to bite in centric occlusion till material sets completely. Excess material was removed using sharp scalpel and fine scissors. Electromyographic Recording with soft Lined Dentures After an adaptation period of 1 month, 3 months and 6 months were made.

For group II: relining the denture using hard chair side lining material were done using direct lining method, following manufacturers instruction, and after one month, 3 months, and 6 months the EMG recording were made as described above.

For group III: Relining the dentures using acrylic resin-based denture liners using direct lining method, the technique previously described, following manufacturers instruction. Electromyographic recording with acrylic lined dentures after an adaptation period of 1 month, 3 months and 6 months.

RESULTS

All patients in the three studied groups attended the different follow up periods of the study.

P-value was 0.792,0.224 after one month and 3 months respectively and 0.041 after 6 months for carrot chewing while for banana chewing it was 0.092< 0.001 and <0.001 after one month, 3 months and 6 months respectively.

Results of Duncan’s test showed that there was *no statistically significant difference* between heat cured and hard liner while soft liner showed a *statistically significant higher mean muscle activity*

TABLE (I) Showing mean and standard deviation of Masseter activity throughout the investigator period.

	Group I soft liner		Group II hard liner		Group III heat cured		
	Mean	SD	Mean	SD	MEAN	SD	P-VALUE
After 1 month CARROT BANANA	1.42	0.18	1.46	0.19	1.47	0.17	0,79
	0.89	0.09	0.8	0.89	0.85	0.09	0.092
After 3 months CARROT BANANA	1.49	0.19	1.37	0.18	1.42	0.15	0.224
	0.94	0.09	0.77	0.07	0.79	0.07	<0.001
After 6 months CARROT BANANA	1.47	0.3	1.36	0.15	1.37	0.15	0.041
	0.95	0.1	0.65	0.08	0.75	0.06	<0.001

Masseter activity throughout the investigator period.

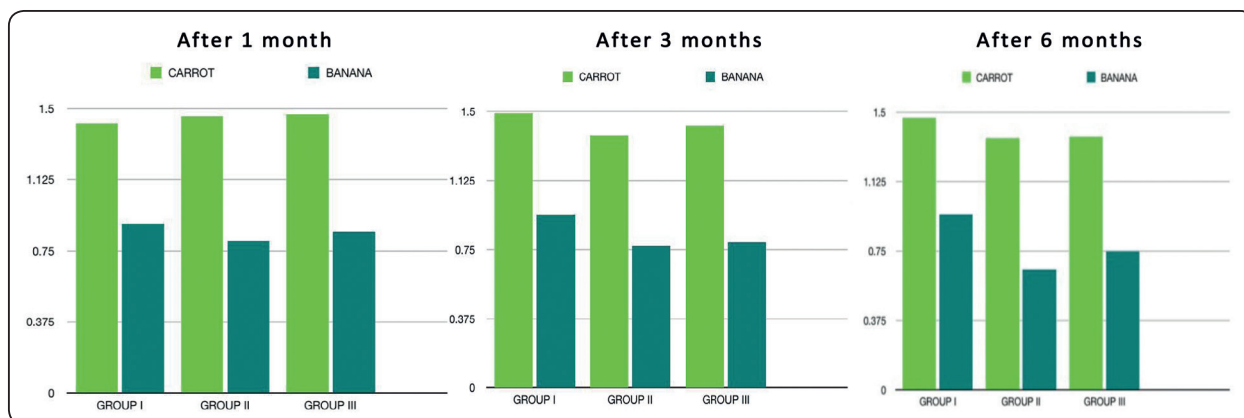
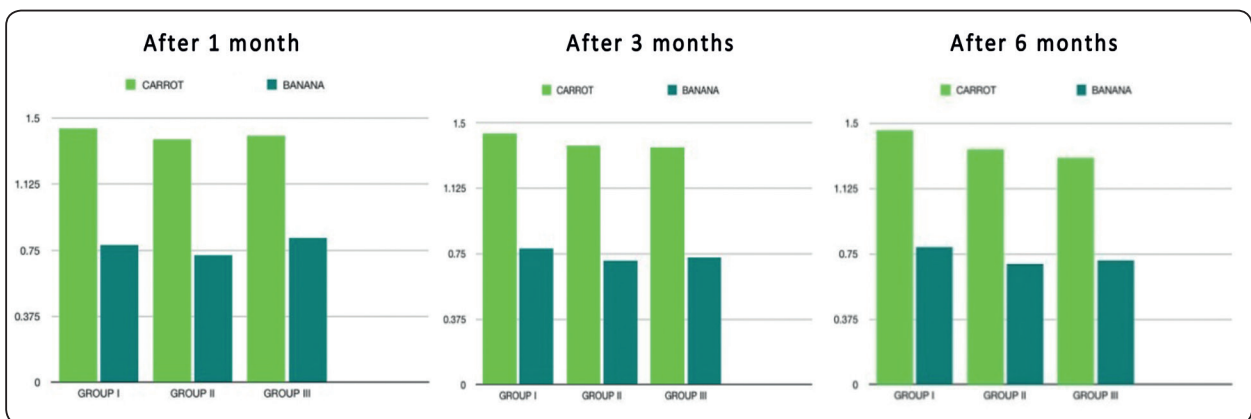


TABLE (II) Showing mean and standard deviation of Temporalis activity throughout the investigator period.

	Group I soft liner		Group II hard liner		Group III heat cured		
	Mean	SD	Mean	SD	MEAN	SD	P-VALUE
After 1 month CARROT BANANA	1.44	0.14	1.38	0.16	1.4	0.15	0.624
	0.78	0.08	0.72	0.09	0.84	0.09	0.145
After 3 months CARROT BANANA	1.44	0.19	1.37	0.15	1.36	0.12	0.291
	0.78	0.09	0.71	0.09	0.73	0.07	0.071
After 6 months CARROT BANANA	1.46	0.13	1.35	0.12	1.3	0.14	0.008
	0.79	0.07	0.69	0.06	0.71	0.08	<0.01

Temporalis activity throughout the investigator period.



than the other two groups in the all observation periods.

P-value was 0.624, 0.291, 0.008 after one month, 3 months and 6 months respectively for chewing carrot while for banana it was 0.145, 0.071 and < 0.01 after one month, 3 months and 6 months respectively.

The statistical analysis revealed that there was a *significant difference* ($P < 0.05$) between the three groups throughout all observation periods. Results of Duncen's test showed that *there was no statistically significant* difference between the

heat cured and hard liner while soft liner showed a *statistically significant higher* mean muscle activity then the other two groups in all observation periods.

Visual analogue scale:

Using independent t-test, it was revealed that there was a significant satisfaction agreement on soft lining material compared to hard lining and heat cured acrylic resin except that for loosening upon speaking, clicking, nervousness and physiognomy which was insignificant difference between the groups.

TABLE (III) Distribution of visual analogue scale on frequently asked parameters as means and standard deviations:

	Frequently asked parameters	N	Conventional heat cured acrylic resin M±SD	Soft liner M±SD	Hard liner M±SD	P-value
Functional	Loosening upon eating	30	6±1.2	8±2.6	6±1.1	0.0003*
	Loosening upon speaking	30	6±1.44	6±0.8	6±1.3	1.000
	Pain during chewing food	30	6±0.93	10±3.33	6±0.89	0.0001*
	Burning sensation under denture and soreness	30	6±0.844	9±2.13	6±0.92	0.0001*
Patient related	Dry mouth	30	7±2.33	10±3.25	6±1.9	0.0001*
	Difficult chewing	30	7±2.51	9±3.66	7±2.49	0.0165*
	Clicking during speaking	30	3±1.06	2±1.01	2±1.05	0.4574
	Nervous because of dentures	30	2.1±1.041	1.8±1.051	1.9±1.04	0.2712
	Heaviness	30	7.24±0.007	3.54±0.0031	7.9±0.0030	0.000*
	Physiognomy	30	6±2.1	7±2.7	6±1.9	0.1147

N; Number, M; Mean, SD; Standard Deviation

**significant difference*

DISCUSSION

All the patients responded regularly to the frequent recalls throughout the investigation periods. All selected patients were not suffering from any muscle disease e.g. myopathy or TMJ disorders as those conditions might have an effect on muscle activity, muscle response and EMG record.⁽¹⁶⁾

The real increase in muscle activity indicated improvement of the functional state of the masticatory system.⁽¹⁷⁾

The increase in muscle activity can be correlated to the improvement in stability and retention of the denture achieved by the resiliency of the soft relining material rather than the hard liner and the heat cured acrylic resin. Better stability gave more comfort to the patients would improve their masticatory performance these results is in agreement with Zhang et al who reported increase in the EMG and bite force during chewing after relining.⁽¹⁸⁾

Kimoto et al reported that use soft liner improved masticatory performance by changing the occlusion phases during chewing⁽⁵⁾.

The questionnaire that was done in this study revealed that patients received dentures relined with soft liner were satisfied with their dentures than the other two groups.

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