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The Effect of Different Thickness of Two Types of Soft Liner on Retention and Electromyography of Complete Denture

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ABSTRACT

Purpose: was to evaluate the effect of different thickness of two types of soft liner (silicone based soft liner and acrylic plasticizer soft liner) on retention and electromyography of complete denture. **Material and Methods:** Ten patients were selected Age ranging from 50-70 year. Patients were randomly divided into two groups (five patients each group). Group(I) **:** Each patient received maxillary and mandibular complete denture processed with heat cured acrylic resin denture base, where the mandibular denture was lined with silicone based soft liner (Promedica) with thickness 1mm (groupI-a) and 2mm (groupI-b). Group (II): Each patient received maxillary and mandibular complete denture processed with heat cured acrylic resin denture base, where the mandibular denture was lined with acrylic plasticizer soft liner (Dura base) with thickness 1mm (groupII-a) and 2mm (groupII-b). Retention was evaluated at insertion, after one month and after three months from delivery .Electromyographic activity was evaluated after one month and after three months from delivery. **Result**: the result of this study showed that there was significant increase in retention and electromyographic activity after lining of mandibular denture with silicone or acrylic based soft liner with thickness 2mm, also there was significant increase in retention after relining of mandibular denture with acrylic based soft liner when compared with silicone based soft liner, while there was no difference between electromyographic activity after relining of mandibular denture with silicon or acrylic based soft liner. **Conclusion:** The thickness of soft liner play an important role in retention and electromograghic activity of the masseter and temporalis muscles, Acrylic based soft liner is more retentive when compared with silicone based soft liner.

KEYWORDS

Silicone based Soft liner, Acrylic based soft liner, Retention, Electromyogragh activity

* Paper extracted from master thesis entitled "The Effect of Different Thickness of Two Types of Softn Liner on Retention and Electromyography of Complete Denture"

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INTRODUCTION

Retention of complete denture is considered one of the difficult problems facing prosthodontics, lower denture has been described to be more challenging compared to the maxillary arch due to mobility of the floor of the mouth, thin thickness mucosa lining the alveolar ridge, reduced support area and motion of the mandible [1].

The difficulties encountered by such patients can be overcome with the use of either implant, adhesive or resilient liners. Although implants are highly effective they are not a viable solution for all edentulous patients because of medical, psychological, and financial reasons. In such a situation, denture liner may be used to compensate for the lost thickness and viscoelasticity of the mucosa [2, 3].

Soft denture liners can be used as a cushion absorbent and it can improve the denture's retention and adaptation[4].The load is evenly distributed over the entire denture bearing area, preventing localized areas of stress concentration [5]. on the other hand, The resilient lining materials shows problems during clinical use, such as weakening of bond between lining and denture, loss of resiliency, color alterations, water sorption and porosity which enhance adhesion of microorganisms onto resilient lining materials and may allow fungal growth [6,7].

According to the composition, the relining materials can be divided into two main groups: plasticized acrylics and silicone elastomers[8].

Soft liner can be used in different thickness. Although they vary, depending on the material used for this purpose, the recommended thickness is about two mm [9].

A vacuum formed spacer can be used to produce a soft liner of uniform thickness regardless of ridge shape. This method is simple, applicable to all ridge forms, and reliably results in a soft lining of a known, uniform thickness [10].

The aim of study was to evaluate the effect of different thickness of two types of soft liner (silicone based soft liner and acrylic plasticizer soft liner) on retention and electromyography of complete denture

MATERIAL AND METHODS

Ten patients were selected . Patient's age ranged from 50-70 years. All Patients were free from any neuromuscular disorder and any debilitating systemic diseases. All patients were selected with edentulous maxillary and mandibular ridge covered with firm mucoperiosteum and healthy mucosa. All patients accept dental treatment and informed about the steps of the study and signed a written consent with Research Ethics Committee (REC) approval. Patients were randomly divided into two groups(five patients each group). Group(I) : Each patient received maxillary and mandibular complete denture processed with heat cured acrylic resin denture base, where the mandibular denture was lined with silicone based soft liner (PROMEDICA Dental Material GmbH Germany) with thickness 1mm (groupI-a) and 2mm (groupI-b) Group (II): Each patient received maxillary and mandibular complete denture processed with heat cured acrylic resin denture base, where the mandibular denture was lined with acrylic plasticizer soft liner (Dura base, Reliance Dental Mfg. Co) with thickness 1mm (groupII-a) and 2mm (groupII-b). Thickness of soft liner was controlled by using a vacum formed spacer .

For group I, Construction of heat cured acrylic resin denture was made as usual manner, vacuum formed spacer with thickness 1mm constructed on mandibular duplicated cast was used to create a space 1mm for silicone based soft liner

Application of silicone based soft liner with thickness 1mm was done using gun and was allowed to flow evenly, as a thin layer to cover the

entire impression surface area of the denture and its borders, then The denture was pressed against the duplicated lower master cast until setting of the soft liner(groupI-a),then the denture was removed from the cast and the excess material was removed using No 15 surgical blade lancet and finished using special stone .

Rebase for lower denture was carried out to produce aspace of 2mm for soft liner using formed vacuum spacer with 2mm thickness and application of silicone based soft liner with thickness 2mm was done as mentioned (groupI-b) .

For group II, Construction of heat cured acrylic resin denture, where the lower denture had space of 1mm thickness formed using vacuum formed spacer with thickness 1mm as mentioned before. The liquid and the powder of the acrylic based soft liner (Dura base) were mixed according to the manufacturer's instructions and was applied to the tissue surface of the denture, with a wood spatula and was allowed to flow evenly as a thin layer to cover the entire impression surface area of the denture and its borders The denture was pressed against the duplicated lower cast until setting of the soft liner .

Rebase for lower denture was carried out to produce a space of 2mm for soft liner using formed vacuum spacer with 2mm thickness and application of acrylic based soft liner with thickness 2mm was done as mentioned (groupII-b) .

Retention evaluation:

Retention was evaluated at insertion ,after one month and after three month using digital forcemeter (Ebalance , China) . The patient was asked to seat in upright position. The measurement point was a hole of 2 mm diameter at the midline between the two lower central incisors. The lower denture was then inserted inside the patient's mouth , patient was asked to sit comfortably with his head on the chin rest and the occlusal plane is parallel to the floor of the room. Chin rest was connected to a metal solid rod with a movable pulley at its end. nylon thread was used in measurement. The first end of nylon was tied in metal ring which attached to the hole formed between central incisors. The other end of nylon thread was passed through the external grooved surface of the movable pulley, and tied to the hook of the forcemeter. The thread was pulled by the forcemeter in a direction away from the patient, dislodging forces was upward 45° to the occlusal plane toward the movable pulley. The force was increased gradually until dislodgement of the lower denture occurred.

Electromyographic evaluation:

Electromyographic evaluation was evaluated after one month and after three months from denture delivery. Surface electromyographic records were obtained from right and left masseter and temporalis muscles by using an electromyographic machine (NeMus 2,EB Neuro S.P.A;Italy).

The recordings were obtained during the following conditions a)-Maximum clenching. b)-Chewing 1cm3 of banana which represents soft food. c)-Chewing 1cm3 of carrot which represents hard food.

Statistical analysis

Data was collected, calculated and statistically analyzed. One way analysis of variance ANOVA was done to compare the retention between the studied groups along the study period. Statistical analysis was performed using Aasistat 7.6 statistics software for Windows (Campina Grande, Paraiba state, Brazil). P values ≤ 0.05 are considered to be statistically significant in all tests.

RESULTS

Evaluation of Retention: the retention results measured in (kg) for all groups .the result obtained were tabulated in tables (1,2) . By inspection of the mean values and standard deviation of retention values. Statistical analysis shows significant higher retention mean value in groupI-b and groupII-b,when compared with groupI-a and groupII-a respectively through follow up period (table 1).

Table (1): *Effect of thickness of soft liner (silicone and acrylic based soft liner) on retention in the studies group*

Variable		Group I-a	Group I-b	P value
		Mean ± SD	Mean ± SD	
Time	at insertion	0.0240±0.009	0.0400± 0. 01	0.0285*
	1 month	0.0360±0.0114	0.0660± 0.0114	0.0032*
	3 months	0.040±0.01581	0.0720± 0.01304	0.0082*
		GroupII-a	Group II-b	P value
		Mean ± SD	Mean ± SD	
	at insertion	0. 420± 0.1304	0.3800± 0.08367	0.5796†
	1 month	0.740± 0. 114	1.080± 0.2588	0.0276*
	3 months	0.808± 0. 1103	1.200± 0.2345	0.0096*

*†non-significant (P>0.05) *significant: (P<0.05)*

By inspection of the mean values and standard deviation of retention values. Statistical analysis shows significant higher retention mean value in groupII-a and groupII-b, when compared with groupI-a and groupI-b respectively through follow up period (table 2).

Table (2): *Comparison of retention results (Mean ± SD) different group of same thickness*

variable		Group I-a	Group II-a	P value
Time		Mean ± SD	Mean ± SD	
	at insertion	0.0240±0.009	0. 420± 0.1304	0.0001 *
	1 month	0.0360±0.0114	0.740± 0.114	0.0001*
	3 months	0.040±0.01581	0.808± 0.1103	0.0001*
		Group I-b	Group II-b	P value
		Mean ± SD	Mean ± SD	
	at insertion	0.0400± 0. 01	0.3800± 0.08367	0.0001*
	1 month	0.0660± 0.0114	1.080± 0.2588	0.0001*
	3 months	0.0720± 0.01304	1.200± 0.2345	0.0001*

*†non-significant (P>0.05) *significant: (P<0.05)*

Evaluation of Electromyograph

Descriptive statistics of the Electromyograph results were tabulated in tables (3,4).

By inspection of the mean values and standard deviation of EMG values. Statistical analysis shows significant higher EMG mean value in groupI-b and groupII-b, when compared with groupI-a and groupII-a respectively through all follow up period (table 3).

By inspection of the mean values and standard deviation of EMG values. Statistical analysis shows non significant difference between silicone and acrylic based soft liner in electromyographic activity(table 4).

Table (3): *Effect of soft liner thickness on EMG in groupI,groupII.*

Silicone based soft liner		Silicone based soft liner (GI-a) 1mm		Silicone based soft liner (GI-b) 2mm		P-value
		Mean	SD	Mean	SD	
Masseter muscle	Hard	190.18	25.91	239.8	34.42	0.0329 *
	Soft	123.75	9.74	207.5	16.90	<0.0001*
Temporalis muscle	Hard	192.58	23.29	247.83	15.54	0.033*
	Soft	143.13	18.21	181.98	29.00	0.035*
Acrylic based soft liner		Acrylic based soft liner (GII-a) 1mm		Acrylic based soft liner (GII-b) 2mm		P-value
		Mean	SD	Mean	SD	
Masseter muscle	Hard	173.8	17.1	242.5	24.91	0.0009*
	Soft	133.5	16.3	195	16.51	0.0004*
Temporalis muscle	Hard	180.5	37.9	248.75	24.80	0.0097*
	Soft	135.5	25.1	190.5	12.07	0.0023*

*Significance level P<0.05, * significant, ns=non-significant*

Table (4): *Comparison of EMG results (Mean ± SD) between different groups of same thickness*

			GI-a		GII-a		P-value
			Mean	SD	Mean	SD	
GI-a and GII-a with thickness 1mm	**Masseter muscle**	**hard**	190.18	25.91	173.8	17.1	**0.28ns**
		soft	123.75	9.74	133.5	16.3	**0.284ns**
	temporali smuscle	**hard**	192.58	33.69	180.5	37.9	**0.6087ns**
		soft	143.13	18.21	135.5	25.1	**0.597ns**
GI-b and GII-b with thickness 2mm			**GI-b**		**GII-b**		
	Masseter muscle	**hard**	239.8	34.42	242.5	24.91	**0.922ns**
		soft	207.5	16.90	195	16.51	**0.271ns**
	temporali smuscle	**hard**	247.83	34.73	248.75	24.80	**0.904ns**
		soft	181.98	29.00	190.5	12.07	**0.652ns**

*Significance level P<0.05, * significant, ns=non-significant*

DISCUSSION

Soft resilient liner aid in increasing retention and stability. The liner materials were applied to the fitting surface of dentures to achieve more equal force distribution, reduce localized pressure and improve denture retention by engaging undercuts [11].

The results of this study showed that there was significant increase in retention in the group I-b (silicone based soft liner 2mm) during the follow up period when compared with group I-a (silicone based soft liner 1mm) and also significant increase in retention in the group II-b (acrylic based soft liner 2mm) during the follow up period when compared with groupII-a (silicone based soft liner 1mm). This finding may be attributed to improvement of the health of gum tissues by absorbing some of masticatory pressure due to cushioning effect of soft resilient liner and this cushioning effect increase with the increased liner thickness , increase thickness of soft liner transmitted less stress to the ridge that make it more comfortable to wear[12].

This finding was in agreement with previous studies [13,14] that showed that increasing soft liner thickness produced lower stresses on the supporting tissues.

The results of this study showed that there was significant increase in retention in the group II-a and group II-b (acrylic based soft liner with thickness 1 and 2mm) when compared with group I-a and group I-b (silicone based soft liner with thickness 1 and 2mm) respectively. This may be due to the lack of union between a silicone based resilient lining and an acrylic denture base material[15] . This result is with the agreement with other studies[16-18], which recommended the use of acrylic resin reline material under the denture base. These studies concluded that acrylic resin reline material had better interfacial bond strength with acrylic resin denture base material. The bonding properties sustained in different oral environmental conditions .

The results of this study showed that there was significant increase in muscle activity of masseter and temporalis muscles in the group I-b (silicone based soft liner 2mm) after 1month and 3 months from insertion when compared with group I-a(silicone based soft liner 1mm) and also significant increase in muscle activity of masseter and temporalis muscles in the group II-b (acrylic based soft liner 2mm) after 1month and 3 months from delivery ,when compared with groupII-a (silicone based soft liner 1mm). This result may be due to the fact that use of soft liner significantly increases the maximum biting force because of even distribution of the occlusal force over the mucosa by these soft materials leading to an increased capacity for stress bearing by residual ridges plus during mastication, the soft lining material improve occlusal balance by its deformation because of elasticity and so the masticatory performance was improved and consequently increased electromyographic activity, as greater energy was expended by muscles to perform the requested action[4,5]. All the previous effect increase with the increased liner thickness as claimed by a previous study[19] that reported that the use of 2 mm thick soft liner material promoted the tendency to decrease the maximum and minimum principal stress in the mucosa and in the underlying bone than 1mm. These findings were in agreement with a study[20] that reported that the maximum and minimum principal stress in mucosa and bone decreased when the thickness of the soft liner material increased up till 2 mm liner thickness.

This study showed that there was no significant difference between silicone based soft liner and acrylic based soft liner. The results obtained are in conformity with the a previous study [5]. This can be explained by the reflex controlled by the sensory input from the mucosa, which may stop the closure of mandible to protect the underlying mucosa from excessive pressure and force. Patient wearing resilient liner lined mandibular denture, experienced less pain and ulcers on the ridge in initial phase of adjustment, therefore having longer occluding phase

of masticatory cycle and could apply more amount of force, as resilient liners due to their viscoelastic property absorb energy and prevent transmission of forces to the underlying tissues[21].

The difference between studies may be due to insufficient accuracy and sensitivity of the electromyographic evaluation to detect differences between both lining materials or may be due to the limitation of follow up period of this study. A longer follow-up might have conceded slightly different results.

CONCLUSION

Within the limitation of this study it was concluded that : The thickness of soft liner play an important role in retention and electromograghic activity of the masseter and temporalis muscle and the optimum thickness of soft liner either acrylic or silicone based soft liner should not be less than 2mm, Acrylic based soft liner is more retentive when compared with silicone based soft liner. There was no significant difference between silicone and acrylic based soft liner in electromyographic activity.

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