



The Effect of Two Heat Cure Soft Tissue Liners on Mandibular Ridge Resorption at Various Time Intervals after Complete Denture Insertion

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ABSTRACT

The use of soft liners became popular in dentistry because they have many clinical advantages. These materials have the ability to help in the healing of the inflamed mucosa, distribute the functional load in the support area of the prostheses, and improve their adaptation and retention. The purpose of this study was to study the effect of two heat cure soft tissue liners on mandibular ridge resorption at time intervals of six months and one year after complete denture insertion.

Material and Method: 30 completely edentulous patients having well-formed ridges were selected as per the inclusion and exclusion criteria. A Randomization chart was used to enroll participants in two experimental and one control groups, who were given mandibular dentures with acrylic-based and silicone-based soft liners and without soft denture liners, respectively. Vertical measurements were made on an orthopantomograph and analysed using a digital caliper at five points, i.e., one at the central incisor and two points at the right and left first premolars, and two in each first molar region.

Result: for all tooth points a significant difference in mean values of bone loss is seen between the three groups, viz, control, acrylic and silicon at different time intervals. At all the time intervals, at all tooth points, minimum bone loss was observed in Group C silicone-based, followed by Group B acrylic-based, and the highest bone loss was obtained in Group A. It was also observed that bone loss at 0 to 6 months was more in all cases, as compared to bone loss at 6 to 12 months.

Conclusion: The use of a soft denture liner significantly reduces the residual ridge resorption in complete denture wearers as compared to conventional denture wearers (without denture liner) over a period of one year of denture insertion.

Keywords: Complete Denture, Edentulous Ridge, Residual Ridge Resorption, Soft Liners.

Introduction

Residual ridge resorption is a chronic, progressive, irreversible, and disabling disease and it has

probably a multifactorial origin. Bone loss varies from patient to patient. and these variations could be attributed to many factors e.g. anatomic,

metabolic, functional or prosthetic.¹ Under the prosthetic factors, the type of denture base material has been cited as one, that influences the rate of residual ridge resorption and in the past three decades this relationship has received increasing attention in the field of Prosthodontics. When forces are applied through a hard base, the supporting tissue can be damaged which results in chronic soreness, abused tissues and bone loss.² Under residual ridge resorption more significant changes occur in the mandibular arch. Tallgren³ and Atwood and Coy⁴ found that the mean ratio of anterior maxillary to anterior mandibular (residual ridge reduction [RRR]) was 1:4. This is because the mandibular ridge bears higher functional forces transmitted through the dentures than the maxillary ridge because the smaller area and less advantageous shape of the mandibular basal seat.¹⁰

Residual ridge resorption, especially in the mandible, may affect denture stability and retention.^{7,9} Gross resorption of the edentulous mandibular alveolar process over a period of time results in excessive loss of the denture-wearing ridge and mostly the overlying thin and atrophic mucosa over it makes it more difficult to withstand the masticatory load. The mucosa gets impinged between the sharp ridge and the denture resulting in severe pain and discomfort to the patient.¹

The difficulties encountered in such patients during function can be avoided with the use of dental implants.^{7,9} Although implants have been reported as highly effective, they are not a viable solution for all edentulous patients because of unfavourable underlying bone, and relevant medical, psychological, and financial constraints. If dental implants are not considered as a suitable treatment option, these problems can be reduced with the help of resilient liners.¹ Treatment with resilient denture liners has only a few limitations, offers a nonsurgical application procedure, and has low treatment costs. The flexibility, resiliency, and shock absorbency of the resilient denture liner

materials help in impact reduction and distribution of masticatory load to the ridge.¹

The use of soft liners became popular in dentistry because they have many clinical advantages. These materials have the ability to help in the healing of the inflamed mucosa⁶, distribute the functional load in the support area of the prostheses and improve their adaptation and retention.¹²

According to the literature, due to the cushioning effect provided by soft liners, a lesser amount of force is transferred to the underlying bone during various functions as compared to one without soft liners. This leads to a reduction in residual ridge resorption.¹

Resilient reline materials are classified as short- or long-term products. Long-term resilient denture liner materials maintain their resilience for longer periods, while short-term liners are recommended for several days or weeks. Liners can be either hard, usually made of polymethyl methacrylate, or resilient, when plasticizers are added to the resin and the silicone elastomers.⁵ Based on the composition, long-term resilient liners have been categorized into two groups Plasticized acrylics and Silicon elastomers. Both of these are commercially available in auto- as well as heat-polymerized forms.⁵ Heat-polymerised silicone permanent soft liners are supplied as a one-paste system with a free radical initiator. This product consists of a polydimethylsiloxane polymer with a pendant or terminal vinyl group for cross-linking. The acrylic permanent soft liners demonstrate viscoelastic behaviour while silicone permanent soft liners demonstrate elastic behavior.⁸

Although the idea of the resilient liners was introduced several years ago, most of the studies were either laboratory¹¹ or clinical observations for their efficacy. As the intraoral environment is the most precise for testing, clinical studies are a must to draw definitive conclusions.¹³ Currently the literature is scanty regarding evidence of the

effect resilient liners have on residual ridge resorption in complete denture wearers.¹

Therefore, the present study was conducted to evaluate and compare the effect of two different soft denture liners on the mandibular ridge resorption in complete denture wearers at various interval of time after denture insertion.

Materials and Methods

This clinical study was conducted on 30 edentulous patients with age groups ranging from

45 to70 years. Both males and females were randomly distributed into two experimental and one control group. Group A (control group) group B (experimental group 1) group C (experimental group 2). Complete medical and dental history was obtained from each patient and they were thoroughly informed about the whole procedure, the need for follow-up visits, and radiographs required during the study. A written informed consent was obtained from each patient.

Groups	No of Patients (N)	Type of complete denture
Group A (control group)	10	Maxillary and mandibular denture in heat cure resin (without soft liner)
Group B (experimental group1)	10	Maxillary dentures in heat cure resin and mandibular denture in heat cure resin +acrylic based soft liner
Group C (experimental group2)	10	Maxillary dentures in heat cure resin and mandibular denture in heat cure resin +silicone based soft liner

Table 1: (Grouping of samples).

Maxillary and mandibular complete dentures were fabricated for all the groups (groups A, B, C) following the standard procedure of complete denture fabrication. The same clinical and lab procedures were carried out for all the groups till the dewaxing stage.

After the dewaxing, the radiopaque markers (guttapercha) were placed over the tooth surface in the ridge lap area of the mandibular denture at five different points [one in the central incisor region, one in 1st premolar and 1st molar region on both sides] figure.1 and secured in position for both experimental and control group (group A, B, and C).

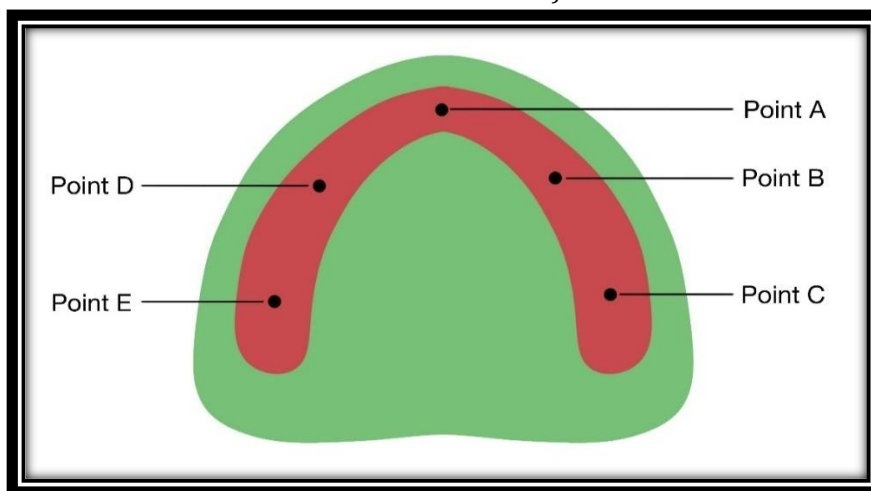


Figure 1: Showing position of radiopaque markers in mandibular denture.

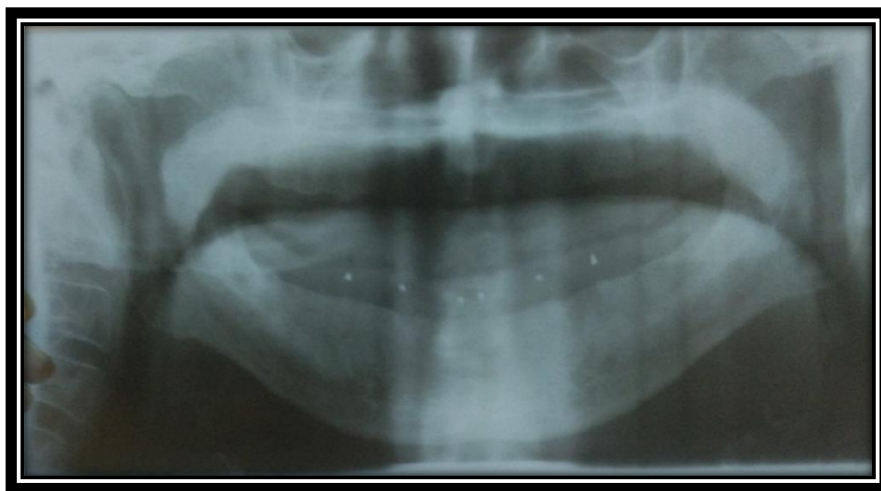


Figure 2: Orthopantomogram showing the position of radiopaque markers in mandibular denture.

In addition to this, for each mandibular denture in group B and group C a wax spacer of uniform 2mm thickness was adapted over the mandibular cast and covered with a cellophane sheet, the remaining space was packed with PMMA [polymethyl methacrylate] resin and flask was tightened in a bench press for trial closer.

After the trial closer, the flask was opened. The spacer and cellophane sheet were removed.

Wax space was replaced after trial closer in group B with a heat-cured acrylic soft denture liner, (Permasoft, Dentsply International, West Philadelphia Street York, PA, USA) and in group C with heat cure silicone-based soft liner (Molloplast B DETAX), and dentures were cured in both experimental groups (group B and C) by short curing cycle in which a flask was put in a bath of cold water, water was gradually allowed to boil over a period of 120 minutes and then allowed to cool slowly using standard curing procedure for PMMA [polymethyl methacrylate] resin.

The dentures in group A were cured in a conventional manner without any denture liner.

After processing, dentures were remounted for occlusal adjustment.

After finishing and polishing the dentures were inserted in the patient's mouth.

For each participant, three panoramic radiographs [OPG] were taken to access the height of bone immediately after insertion and, the amount of bone resorption at six months and twelve months after denture insertion. To assure reproducibility between successive films, all the radiographs were taken on the same OPG machine by a trained radiographer using a standard protocol and blinded about the use of soft denture liner.

For the measurement of bone height, the inferior border of the mandible and lower border of the radiopaque markers at five different regions (2 in 1st premolar, 2 in 1st molar, and 1 in midline) were considered as reference points. (as done by Dinesh Babu, and Veena Jain) The distance from radiopaque markers to the lower border of the mandible was measured with the help of a digital caliper. All the measurements were performed by two independent and blinded examiners to minimize operator-based bias and error. In the case of different values, measurements were verified again.

The magnification error for each participant was corrected by measuring the distance from the mandibular notch to the gonion on each radiograph. Measurements recorded immediately after denture insertions were considered as baseline values and measurements made at 6

months and 12 months were adjusted according to the baseline radiograph.

The following equation represents an example of a correction factor:

Correction factor == Notch to gonion distance at denture insertion

Notch to gonion after 6 months or 12 months

The values on each side were multiplied by the correction factor. To avoid any horizontal error, right and left sides of mandible were treated as separate and multiplied with respective factors.

The data thus obtained were subjected to statistical analysis using SPSS statistical software package version 16.0

Result

Intergroup comparison of bone loss (mm) estimated with one-way ANOVA with descriptive summary comprising mean and SD are presented in Table II. The table shows that for all tooth points a significant difference in mean values of bone loss is seen between the three groups, viz, control, acrylic, and silicon at different time intervals.

At all the time intervals, at all tooth points, minimum bone loss was observed in Group C, followed by Group B, and the highest bone loss was obtained in Group A. It was also observed that bone loss at 0 to 6 months was more in all cases, as compared to bone loss at 6 to 12 months.

The one-way ANOVA results showed that the intergroup comparisons (comparison between control, silicon, and acrylic groups) of bone losses at a time interval were statistically significant.

Tooth points	Time interval	Group A N=10		GROUP B N=10		GROUP C N=10		F	p - value
		Mean	SD	Mean	SD	Mean	SD		
		Central incisor (point A)	0 to 6 month	0.89	0.17	0.68	0.22		
	6 to 12 month	0.68	0.09	0.46	0.17	0.22	0.04	40.1	0.000
	0 to 12 month	1.57	0.15	1.14	0.24	0.67	0.13	64.7	0.000
Right molar (point B)	0 to 6 month	0.91	0.19	0.70	0.20	0.42	0.10	21.3	0.000
	6 to 12 month	0.68	0.15	0.48	0.15	0.20	0.09	30.9	0.000
	0 to 12 month	1.59	0.32	1.18	0.28	0.62	0.13	35.5	0.000
Right premolar (Point C)	0 to 6 month	0.82	0.10	0.68	0.12	0.46	0.12	25.0	0.000
	6 to 12 month	0.60	0.13	0.40	0.12	0.20	0.09	30.0	0.000
	0 to 12 month	1.42	0.15	1.08	0.15	0.66	0.14	65.7	0.000
Left molar (Point D)	0 to 6 month	0.87	0.16	0.67	0.23	0.46	0.12	13.4	0.000
	6 to 12 month	0.65	0.20	0.44	0.10	0.23	0.05	26.3	0.000
	0 to 12 month	1.52	0.26	1.11	0.27	0.69	0.13	32.9	0.000
Left	0 to 6 month	0.85	0.17	0.69	0.13	0.41	0.07	28.9	0.000

premolar	6 to 12 month	0.63	0.19	0.42	0.12	0.20	0.08	24.3	0.000
(Point E)	0 to 12 month	1.48	0.28	1.11	0.14	0.61	0.10	54.0	0.000

N=number of patients

Table 2: Comparison of mean bone loss (mm) at different tooth points between group A, group B, and group C at different time intervals.

Discussion

In the current study, laboratory-processed acrylic-based soft liner (Permasoft) and silicone-based denture soft liner (Molloplast-B) were used. based on their availability and usage. All the steps of complete denture fabrication were carried conventionally up to dewaxing stage and dentures were cured in both experimental groups (groups B and C) by short curing cycle in which flask was put in a bath of cold water, water was gradually allowed to boil over a period of 120 minutes and then allowed to cool slowly using standard curing procedure for PMMA [polymethyl methacrylate] resin as per the manufacturer instruction given in permanent liners (Carl-Zeiss-Str.4.7627 Ettlingen/Germany Telefon:07243/510-0 www.detax.de.post@detax.de) as their properties were best maintained by short curing cycle.

The thickness of soft-liner material was kept at 2 mm because a thickness of 2.5 mm resulted in a slightly higher level of stress.¹⁶ A possible explanation for the above could be the instability of the prosthesis over the recliner material above a certain height of the same. This is in agreement with data presented by Kawano et al.¹⁴ and Lima et al.²⁵ They stated that the thickness of the soft liner played a significant role in the stress distribution, especially in patients with thin mucosa.²⁵

Resorption of the residual ridge has been estimated with various radiographic techniques such as lateral cephalometric and panoramic radiographs. Panoramic radiography was used in this study because an image of both jaws can be produced on one film quickly and conveniently with relatively less radiation exposure.²² In the current study, a reference line was drawn touching the inferior border of the mandible. From this line, vertical lines were drawn to the lower border of

the radiopaque markers in five different regions. According to Xie et al.,²² if reference lines and measured points are located in the same vertical plane or approximately the same plane as the teeth, variations in vertical measurements in the mandible and maxilla are within a small range.²² Enlow et al.¹⁷ described the distribution of surface fields of resorption and deposition in all parts of the edentulous mandible and stated that residual ridge resorption is usually more rapid in the premolar and molar region than the anterior region of the mandible due to the lower position of the reversal line in the posterior region. Hence, it is especially important to record the resorption in the anterior and posterior regions of the mandible.¹⁷ So The above-mentioned reference points were marked and residual ridge resorption were measured at these point at various time interval. The height of the residual ridge was measured from the lower border of the radiopaque marker to the inferior border of the mandible because according to Wical and Swoope²³ mandibular inferior edge is a, relatively constant landmark despite the increasing age or alveolar process resorption.

At all the time intervals, at all tooth points, minimum bone loss was observed in group C, followed by group B, and the highest bone loss was obtained in group A. It was also observed that bone loss at 0 to 6 months was more in all cases, as compared to bone loss at 6 to 12 months. It has been observed that the mandibular resorption rate was greatest in the earlier stages of edentulism and slowed with the longevity of edentulism. This is in accordance with Tallgren³, who stated that RRR was greater during the first few months after the tooth extraction than in later years of the edentulous state.³

The one-way ANOVA results showed that the intergroup comparisons (comparison between groups A, B, and C) of bone losses at a time interval were statistically significant ($p < 0.05$).

There is a statistically significant difference in bone loss between conventional and soft-lined dentures in all regions compared to the control group over a period of 12 months. Similar results were obtained by Elcharkawi and ElMahdy²¹, when the bone loss in the mandible after 6 months of denture delivery was compared with and without soft liners.²¹ Babu et al.¹ also obtained the same results when comparing bone loss in the mandible after 6 and 12 months of denture insertion with and without soft liners.^{1,21} Less resorption with group C- as compared to group B can be explained by the fact that acrylic resin materials exhibit a more marked change in viscoelastic properties and loss of cushioning effect over time than silicones^{18,19} as stated by Hiroshi et al.¹⁹ From the standpoint of durability, silicones are preferred as stated by Mohamed Hussein et al.²⁰ According to them, silicone base liners perform better than acrylic baseliners in maximum bite force and masticatory efficiency.²⁰ According to Rasleen et al.²⁴ silicone-based soft denture liners performed significantly better than acrylic-based soft denture liners when compared for colour stability, surface hardness, tensile bond strength, water sorption, and solubility, The softness of silicon-based liners is controlled by the degree of cross-linkages between the polymer chains and the presence of fillers. Thus, quite unlike the case of acrylic-based liners, they do not require the presence of leachable plasticizers to produce the desired softening effect. Consequently, they are capable of retaining their desired properties for prolonged periods and are considered to be more durable.²⁴

Conclusion

However, the present study had certain limitations. The main limitation of this study was the short study period. Only two commonly available denture liners were used in the study and the data was collected from a limited population.

Further studies can be carried out on a larger population including other denture liners as well. The cushioning effect of soft liners decreases over time so more long-term studies can be carried out on this subject.

Keeping in mind the limitations of this in-vivo study, the following conclusions can be drawn.

1. Statistically significant mandibular ridge resorption was observed in both experimental groups and the control group at intervals of six months and one year.
2. It was also observed that ridge resorption at 0 to 6 months was more in all cases, as compared to ridge resorption in 6 - 12 months.
3. A similar pattern of ridge resorption was observed on the right and left sides of the mandible.
4. The use of soft denture liners significantly reduces the residual ridge resorption in complete denture wearers as compared to conventional denture wearers (without denture liner) over a period of one year.
5. Less ridge resorption was observed in dentures incorporating silicone-based liner as compared to dentures incorporating acrylic-based liner and conventional dentures (without liner) over a period of one year.

Although ridge resorption has occurred in all three groups, the rate of ridge resorption under dentures incorporating a resilient material is apparently much less than that which occurred under conventional dentures. The use of a complete denture with a soft denture liner significantly decreased the rate of residual ridge resorption as compared to the one with conventional dentures. The unique abilities of resilient liner materials to control the distribution of stress over the denture-bearing mucosa and to provide a cushioning effect to the cyclic forces of mastication make them suitable for a wide range of applications in the field of prosthetic dentistry.

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