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ORIGINAL ARTICLE

A Comparative Study to Evaluate The Softness of Heat Processed and Auto Polymerized Denture Relining Materials When Stored in Hard and Soft Water- An Invitro Study

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ABSTRACT

Aim: To evaluate the effect of hard and soft water on softness of three commercially available soft liners.

Material and Methods: 8 specimens of 3mm height and 41mm diameter were fabricated from each soft liner on acrylic resin base of 3mm height and 44mm diameter. The specimens were stored in artificial saliva (Wet mouth, ICPA product) for14 hours in a day, at 37°C in an incubator and the rest of the time 4 specimens from each group were stored in hard water and 4 in soft water. Softness of each specimen was recorded using Shore-A durometer at the end of 1st, 7th, 15th, and 30th day.

Results: When compared between hard and soft water, the autopolymerized acrylic and autopolymerized silicone soft liners had significant reduction in softness on 7th day in hard water. The autopolymerized acrylic soft liner had least softness in both hard and soft water. The heat polymerized acrylic soft-liner showed maximum softness in both hard and soft Water.

Conclusion: Heat polymerized acrylic soft liner was proven to be softer than the other two materials followed by autopolymerized silicone and autopolymerized acrylic soft liners.

Keywords: Flexacryl soft, Super soft, GC Reline soft, Softness, Hard water and soft water

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INTRODUCTION

Soft lining materials have been used in dentistry for more than a century, with the earliest being natural rubber (1,2). Today, soft lining materials include silicone soft-liners and plasticized acrylic resins.

A considerable number of denture wearers have chronic soreness during normal functioning (3). This is even more pronounced for those patients who have diabetes mellitus or other debilitating diseases or for geriatric patients (4). Soft-liners are valuable when treating such patients and

patients with ridge atrophy or resorption, bony undercuts and bruxing(4, 5).

During denture use soft-liner is constantly bathed in saliva and during storage, they may be soaked in aqueous cleansing solutions or in water. Most natural water supply contains some hardness due to dissolved calcium and magnesium, when stored in such water; the inorganic salts may have some adverse effects on the softness of the soft liner because of leaching out of plasticizers and absorption of water or saliva (5-9).

Several investigators have studied the softness of soft liner after immersing them separately in water or artificial saliva, where as this study was conducted to evaluate the softness, of soft liner after they are stored in artificial saliva, hard water and soft water to simulate oral and denture storage conditions.

MATERIAL AND METHODS

Three types of soft liners were used for this study to evaluate the change in the softness. Name, type of soft lines and manufacturer are listed in Table 1.

Preparation of specimens

8 specimens were prepared from each soft liner and were divided into 2 groups for hard water and soft water.

Soft liners are lined over the acrylic resin specimens in order to mimic the specimens to complete denture.

A precise two plate metal mould was fabricated which can be separated and realigned accurately. Metal ring of internal diameter 44mm and 3mm height was used to prepare wax patterns of uniform size. The metal ring was placed on the lower portion of the metal mold and melted modelling wax was poured into the ring, upper portion was then realigned and held in position until the wax was hardened. All the wax patterns were recovered and numbered according to the groups. The specimens were then invested in conventional denture flask with plaster of paris and dewaxing was done. A thin film of cold mold seal was applied and allowed to set. Heat cured acrylic resin was mixed according to manufacturers instructions and packed in dough stage with a cellophane sheet over it using compression molding technique. Trial closure was done. After removing the excess flash, the flask was closed completely and left for bench curing for 30 min at room temperature. Then the flask was kept in the water bath and cured according to the manufacturers instructions (30 min at 65°C / 158°F and boiled for next 30 min).

After polymerization, the flask was allowed to cool to room temperature. The specimens were recovered, trimmed and polished. Total of 24 specimens were made in this manner.

Procedure to reline the acrylic specimens

To reline the acrylic specimen, a metal ring of internal diameter less than the diameter of acrylic specimen was used. Three "V" shaped grooves were cut on the ring for the excess material to flow.

Relining the acrylic specimens with autopolymerized acrylic soft liner

Cellophane sheet was kept on the lower portion of the metal mold. On that a metal ring was placed. The liner was mixed according to recommended powder/liquid ratio for 2 min (7 cc of powder/4 ml of liquid) and the mix was packed into the metal ring. The prepared acrylic resin specimen was then placed accurately on the metal ring and upper portion of metal mold was realigned. The specimen was allowed to polymerize for 20 min. using the metal ring as a guide the excess flash was cut with a sharp blade and specimen was recovered. 8 specimens were lined in this manner with Flexacryl soft acrylic soft liner (Figure 1).

Relining the acrylic specimens with autopolymerized silicone soft liner

Cellophane sheet was kept on the lower portion of metal mold over that a metal ring was placed. The ready mix of the material was dispensed into the ring and acrylic specimen was placed accurately on top of the ring and the upper portion of the metal mold was realigned. Specimen was allowed to polymerize for 5 min. using a metal ring as a guide the excess flash was removed with a sharp blade and specimen was recovered. 8 acrylic specimens were lined in this manner with G.C.Reline soft silicone soft-liner.

Relining the acrylic specimens with heat polymerized acrylic soft liner

Wax pattern of 44mm diameter and 3mm height was made using the metal ring. The wax specimen was placed on the previously fabricated acrylic resin specimen and borders were sealed.The specimen was then invested in a conventional denture flask with plaster of paris. Dewaxing was done. Separating media was applied on the plaster. Any separating media on the acrylic resin specimen was carefully removed with cotton and allowed to dry. The liner was mixed

Table 1: Materials, type and manuafacturers of soft liners used in this study

Material	Type	Manufacturer
Flexacryl soft	Autopolymerized, acrylic based soft liner	Lang dental manufacturing company, Inc. wheeling, U.S.A
Super soft	Heat polymerized, acrylic based soft-liner	G.C. America Inc.
GC Reline soft	Autopolymerized, silicone based soft-liner	G.C. Corporation, Tokyo, Japan.

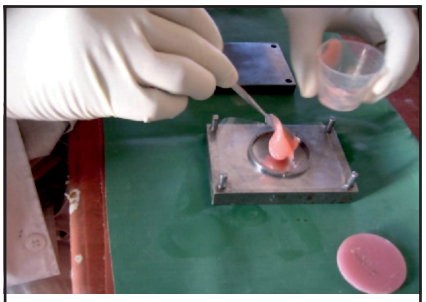

Figure 1: Metal mould and metal rings

according to recommended powder/liquid ratio (5gm/4ml) for 20 to 30 seconds. Liner was packed when the mixture was no longer tacky (30 to 40 min) and trial closure was done. Cellophane sheet was removed carefully and excess liner was cut using a sharp blade. Final closure was done and the flask was kept in hot water (165°F) for approximately 30min. Over the period of next 30 min, the temperature of the water was slowly increased to boiling and maintained for 10 min. After curing the specimen was recovered and kept in ice water for 5 min prior to polishing. Specimen was trimmed and polished. 8 acrylic specimens were lined in this manner with Supersoft acrylic soft liner.

Testing

The measurement is based on the penetration of an indenter 1/32-inch in diameter into a specimen. The indenter is attached to a scale reading from 0 to 100 Shore-A units. Material with a lower Shore-A hardness number is softer than those with a higher number. The specimen was kept on a flat table and the instrument was held in a vertical position while pressure was applied until the foot of the instrument touched the surface of the specimen. Readings were taken after firm contact was achieved between the durometer foot and the material tested. The specimens were grouped and stored in artificial saliva (Wet mouth, ICPA product) at 37°C in an incubator for 14 hours in a day and the rest 10 hours they were stored in hard and soft water separately. Readings were taken at the end of 1st, 7th, 15th and 30th day. The readings obtained were tabulated and statistical analysis was done using Independent sample t test and compared using one way ANOVA

Table 2: One way analyses of variance in hard water

Shore A hardness Units		N	Mean	Standard deviation	Minimum	Maximum
Day 1	Flex	4	55.5625	.1250	55.50	55.75
	SS	4	34.3750	.2500	34.00	34.50
	GC	4	58.8125	.2394	58.50	59.00
	Total	**12**	**49.5833**	**11.3189**	**34.00**	**59.00**
Day 7	Flex	4	56.8125	.1250	56.75	57.00
	SS	4	36.0000	.0000	36.00	36.00
	GC	4	60.5000	.2887	60.25	60.75
	Total	**12**	**51.1042**	**11.2666**	**36.00**	**60.75**
Day15	Flex	4	70.8125	.6250	70.00	71.50
	SS	4	44.1875	.7465	43.25	45.00
	GC	4	66.6250	.3227	66.25	67.00
	Total	**12**	**60.5417**	**12.2214**	**43.25**	**71.50**
Day 30	Flex	4	79.1250	.5951	78.75	80.00
	SS	4	46.1250	.1443	46.00	46.25
	GC	4	66.2500	.8660	65.00	67.00
	Total	**12**	**63.8333**	**14.1948**	**46.00**	**80.00**

Table 3:. One way analysis of variance in soft water

Shore A hardness Units		N	Mean	Standard deviation	Minimum	Maximum
Day 1	Flex	4	55.5625	.4270	55.00	56.00
	SS	4	34.7500	.3536	34.50	35.25
	GC	4	58.8750	.2500	58.50	59.00
	Total	**12**	**49.7292**	**11.1572**	**34.50**	**59.00**
Day 7	Flex	4	56.3125	.3146	56.00	56.75
	SS	4	36.0000	.0000	36.00	36.00
	GC	4	59.6250	.3227	59.25	60.00
	Total	**12**	**50.6458**	**10.9110**	**36.00**	**60.00**
Day 15	Flex	4	70.5625	.4270	70.00	71.00
	SS	4	45.0000	.0000	45.00	45.00
	GC	4	66.6875	.4732	66.00	67.00
	Total	**12**	**60.7500**	**11.7536**	**45.00**	**71.00**
Day 30	Flex	4	78.5000	.4564	78.00	79.00
	SS	4	46.7500	.2041	46.50	47.00
	GC	4	67.5000	.4564	67.00	68.00
	Total	**12**	**64.2500**	**13.7539**	**46.50**	**79.00**

RESULTS

With in the limitations of this in vitro study the following results were drawn: the mean values and SDs are tabulated in Table 2 and Table 3.

When compared between hard and soft water, the autopolymerized acrylic soft-liner showed higher Shore-A hardness changes in hard water i.e., 42.41% in contrast with soft water i.e., 41.28%.

Autopolymerized silicone soft-liner showed decrease in Shore-A hardness in hard water i.e., 12.65% in contrast with soft water i.e., 14.65%.

The heat polymerized acrylic soft-liner showed decrease in Shore-A hardness in hard water i.e., 33.75% compared to soft water i.e., 34.19% (Figure 2 and 3).

When compared between materials, the autopolymerized silicone soft-liner was proved to be softer in both hard and soft water. Followed by heatpolymerized acrylic and autopolymerized acrylic soft-liner (Figure 2, and 3).

DISCUSSION

Shore-A durometer has been an effective way to measure the hardness or softness of soft liners according to ASTM: D2240. Its units represent the hardness of the material. As the units increases the hardness of the material increases (10-13).

The results of the table 2 and 3 and graphs 1 and 2 show the mean softness of soft liners at various intervals when stored in

hard and soft water. The softness of the liners studied, varied considerably with the type of material and mode of polymerization.

When compared between hard and soft water, the autopolymerized acrylic soft liner showed higher Shore-A hardness units in hard water on 7th day and 30th day but the change was significant only on 7th day. There was no significant difference in hardness on 15th day in both hard and soft water. The increase in hardness on 7th and 30th day might be because of absorption of hard water contains high minerals than soft water. The autopolymerized acrylic based soft liner (Flexacryl soft) demonstrated higher hardness units on 1st day, 15th day and 30th day both in hard and soft water when compared with heat polymerized acrylic based soft liner (Super soft) and autopolymerized silicone soft liner (GC Reline soft). The results are in agreement with the previous studies conducted by Zvi yoeli (7). The increased hardness of autopolymerized acrylic soft-liner might be because; the plasticizers are not stable in aqueous environment viz. oral cavity and in storage conditions. Plasticizers tend to leach out, causing the material to loose its softness (7, 14-16).

The heat polymerized acrylic soft-liner showed higher Shore-A hardness units in soft water on 15th day and 30th day when compared with hard water but this difference was statistically significant only on 15th day. There was no statistically significant difference in softness when tested on 7th and 30th day in both hard and soft water. In heat cured acrylic soft liner the plasticizers are more stable because of more complete polymerization at higher temperature (7, 17-19), so this soft liner was softer than the other two liners at the end of the 30th day at all intervals in both hard and soft water. This may be due to the chemical composition and/or complete polymerization (17-20).

When compared between hard and soft water, the auto polymerized silicone soft-liner demonstrated higher hardness values in hard water on the 7th day when compared with soft water but finally on the 30th day autopolymerized silicone soft-liner demonstrated higher hardness values in soft water when compared with hard water. This change in hardness of liners in hard and soft water might be because of high inorganic salt content in hard water. Even though the heat polymerized acrylic soft-liner showed lower hardness values at the end of 30th day, the autopolymerized silicone soft-liner was proved to be more stable. This is because the rate at which the auto polymerized silicone soft-liner became hard was less when compared with other two liners both in hard and soft water (21).

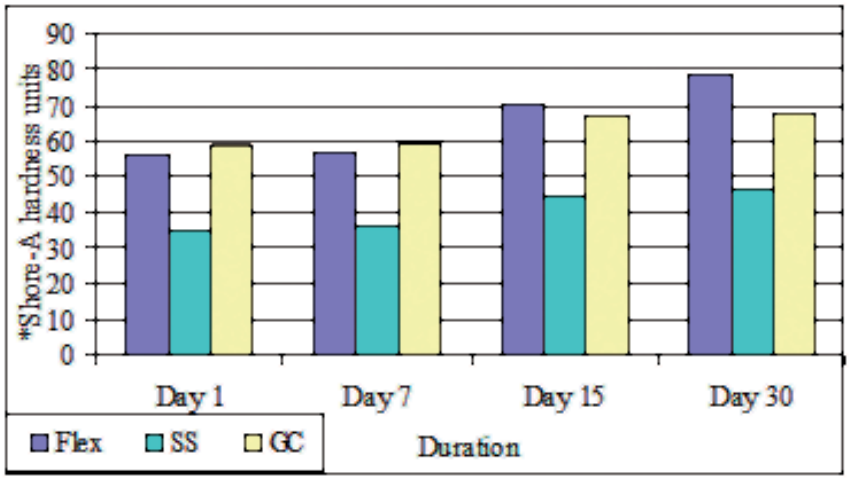

Figure 3: Mean hardness in soft water

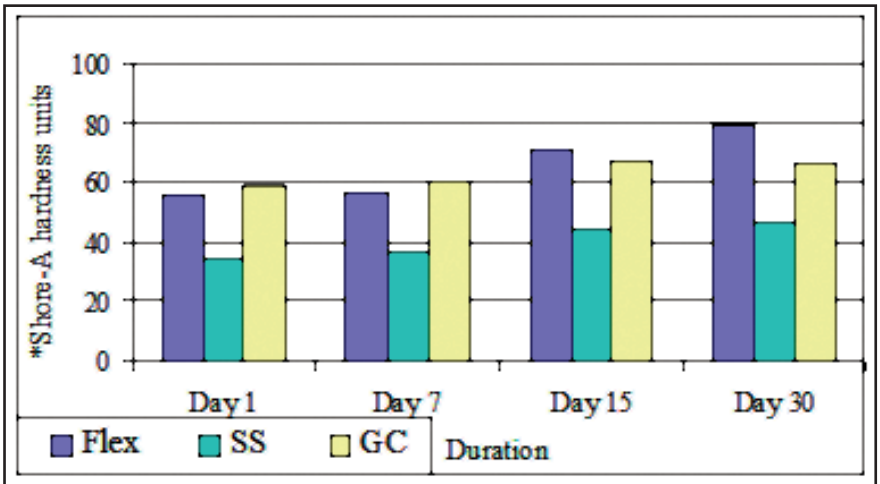

Figure 2: Mean hardness in hard water

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ABBREVIATIONS

Flex: Flexacryl soft autopolymerized acrylic denture soft liner

SS: Super soft heat polymerized acrylic denture soft liner

GC: GC reline soft autopolymerized silicone denture soft liner

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