



COMPARATIVE EVALUATION OF DIMENSIONAL ACCURACY OF THREE DIFFERENT RELINING MATERIALS AT POSTERIOR PALATAL SEAL AREA- AN IN VITRO STUDY

Dental Science

Dr. Soniya Aswale	Post Graduate Student, Dept Of Prosthodontics, Sharad Pawar Dental College, Wardha (Sawangi), Maharashtra, India
Dr. Anjali Bhojar Borle	Head Of Department, Dept of Prosthodontics, Sharad Pawar Dental College, Wardha (sawangi), Maharashtra, India
Dr. Surekha Dubey	Professor, Dept of Prosthodontics, Sharad Pawar Dental College, Wardha (sawangi), Maharashtra, India
Dr. Mithilesh Dhamande	Reader, Dept of Prosthodontics, Sharad Pawar Dental College, Wardha (sawangi), Maharashtra, India
Dr Shivani Patel	VSPM Dental College, Hingna, Nagpur. Maharashtra, India

ABSTRACT

Purpose: The posterior palatal seal is a very important determinant in retention of the complete denture. It can be subjected to distortion during the relining procedures. The purpose of this study was to evaluate the dimensional accuracy of various denture relining materials on the maxillary posterior palatal seal area.

Materials and Methods: A stainless steel cast was constructed from an ideal maxillary edentulous cast. Fifty identical complete dentures were fabricated on 50 definitive casts made from the original metal cast. Five relining methods and materials were evaluated during this study, in regards to posterior palatal seal distortion: (I) laboratory conventional heat-polymerizing (Lucitone), (II) conventional auto polymerizing resin : DPI-RR, (III) chair side relining material (Monosill) . The dimensional change occurred in the region of posterior palatal seal areas were determined by placing a low-viscosity silicone impression material between the metal cast and the tissue surface of the relined dentures. The thickness of the silicone was measured at five predetermined points, under a measuring microscope. Statistical analysis was performed using descriptive statistics, One way Anova test, Tukey's HSD test.

Results: The gap at the posterior palatal seal area ranged from 247 to 773 μm , when measured at the five predetermined points. Point E exhibited the smallest mean gap in group III and least in point C and Group I revealed the largest mean discrepancy. The different relining methods and materials presented statistically significant differences ($p < 0.0001$).

Conclusion: The chairside autopolymerizing relining material exhibited smaller gap recordings than the rest of the tested complete denture relining materials at posterior palatal seal area.

KEYWORDS

INTRODUCTION:

The factors important for the success of the prosthesis are its retention, stability and support. The process of alveolar bone resorption is inevitable, which eventually affects the fit of the prosthesis over a period of time, due to which the fit of complete denture is altered and the denture becomes loose, resulting in lack of stability and desired retention.^{1,2,3,4} This can induce irritation, inflammation and soreness of the underlying tissue, which can be more appropriately termed as abused oral mucosa. As there is loss of supporting hard and soft tissues, which forms a foundation for the complete denture prosthesis, resulting in loss of occlusal vertical dimension. This altered vertical dimension further complicates the situation from the point of esthetics and function of the prosthesis. Thus there is a need to reline and rebase the complete dentures to improve the stability and retention of the prosthesis, to offer optimal health of oral tissues and assure desired quality of esthetics and function to the patient.^{5,6,7,8} The term reline is defined as "to resurface the tissue side of a denture with new denture base material to make it fit more accurately."

During the procedure of relining, the posterior palatal seal area is one of the most important area for stability and retention.¹⁰ GPT-9 defines posterior palatal seal area as "the soft tissue area at or beyond the junction of hard and soft palate on which pressure can be applied in physiologic limit, can be applied to aid in retention."⁹ This soft tissue provides a seal around the posterior border of maxillary denture.¹¹ The primary function of posterior palatal seal area is to provide the peripheral seal and contribute to the retention of the complete denture. Peripheral seal being the primary function, other functions includes compensation for polymerization shrinkage of acrylic resin thereby blocks air and food entry beneath the denture. Relining the dentures often pose problems in dimensional accuracy,^{12,13} thus it is necessary to know the discrepancy after relining attributed to material used and also the method of relining. This study was therefore planned and performed to evaluate the dimensional accuracy of relined maxillary

complete denture at posterior palatal seal area using three materials for relining.

MATERIAL AND METHODS:

A specially designed metal stand was fabricated with handle attachment which was used to apply desired weight on the specimen while relining. The specimen dentures were relined using autopolymerizing and chair side relining material using this stand (Image). A mould of a metal maxillary edentulous stone die was fabricated with triangular "v" shaped notches were made on the horizontal land (the border) at the region of posterior palatal seal area and 20 definitive stone casts were obtained (Image 2). Modeling wax, of thickness 1.5 mm was adapted over the metal die as a spacer at the posterior palatal seal area. This modified metal die was then duplicated using silicone duplicating material. The mould obtained was then poured with type III dental stone to obtain total 60 spaced definitive casts. These casts were then used for the fabrication of the complete denture specimen which was used in this study for relining with three different relining materials. These denture bases when seated on definitive cast will have a space of 1.5mm only in the posterior palatal seal area, which will be loaded with selected relining material as per the study protocol. Specimen dentures with only occlusal rims were fabricated on the definitive cast exhibiting the space available for relining material.

Group I: Relining Method- Laboratory conventional heat polymerization and Relining Material-Heat polymerizing resin (Lucitone)

Group II: Relining Method- Laboratory conventional auto polymerization and Relining Material-Auto polymerizing resin

Group III: Relining Method- Chair side auto polymerization and Relining Material- Mollosil (chairside soft relining)

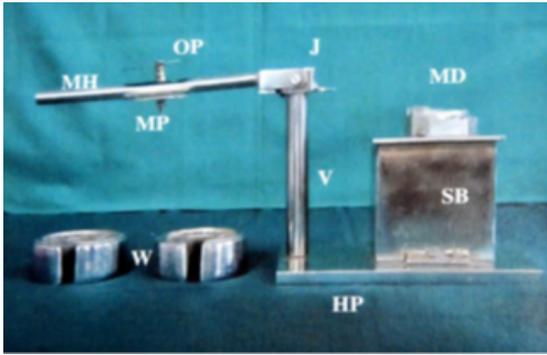


Image 1. The Metal Stand



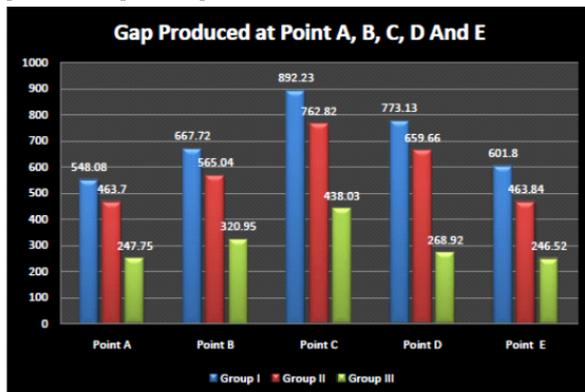
Image 2. The Definitive Cast

RESULTS:

Table 1: Comparison of the mean gap produced (in µm) at point A, B, C and D of the posterior palatal seal area by different relining methods.

Points	Group I (n=20) (Chair side soft relining material)	Group II (n=20) (Auto polymerizing resin)	Group III (n=20) (Heat polymerizing resin)	P-Value
	Mean ± S.D.	Mean ± S.D.	Mean ± S.D.	
A	548.08±45.57	463.70±30.39	247.75±29.34	<0.001
B	667.72±39.45	565.04±52.94	320.95±28.45	<0.001
C	892.23±30.93	762.82±40.54	438.03±32.52	<0.001
D	773.13±31.58	659.66±41.58	268.92±36.56	<0.001
E	601.80±27.81	463.84±62.18	246.52±24.44	<0.001

Table No. 1 shows that the gap produced at point A, B, C, D and E of the posterior palatal seal area by three different relining methods was compared. The analysis done by one-way ANOVA showed statistically significant differences (p<0.001) in mean gap values at point A, B, C, D and E of posterior palatal seal area. Overall the group III (chair side soft relining material) had the least gap at all the measured points on each points on the posterior palatal seal area. The group III had least gap at point E of the posterior palatal seal area.



Graph 1: Comparison of the mean gap produced (in µm) at point A, B, C and D of the posterior palatal seal area by different relining methods.

Table No. 2: Post hoc pair wise comparison of gap produced at point A, B, C, D and E of the posterior palatal seal area by different relining methods (in µm)

Groups	Group I v/s Group II	Group II v/s Group III	Group I v/s Group III
Point A	M.D.*	84.37	300.33
	95% C.I.#	57.06 - 111.68	273.02 - 327.63
	P value	<0.001	<0.001
Point B	M.D.*	102.68	244.08
	95% C.I.#	71.09 - 134.27	212.49 - 275.67
	P value	<0.001	<0.001
Point C	M.D.*	129.4	324.79
	95% C.I.#	102.83-155.98	298.21-351.36
	P value	<0.001	<0.001
Point D	M.D.*	113.47	390.73
	95% C.I.#	85.46-141.48	362.73-418.74
	P value	<0.001	<0.001
Point E	M.D.*	137.95	217.32
	95% C.I.#	106.16-169.75	185.52-249.11
	P value	<0.001	<0.001

M.D. Mean Difference, #C.I. Confidence Interval

Table No. 2 shows that the post hoc pair wise comparative analysis also showed significant differences in mean gap values at all points; A, B, C, D and E of the posterior palatal seal area. At all points of posterior palatal seal area, when group I was compared with group II, mean difference was found statistically significant (p<0.001), when group II was compared with group III, mean difference was statistically significant (p<0.001) and also when group I was compared with group III, mean difference was statistically significant (p<0.001).

DISCUSSION:

In the current study, the values obtained for point A, B, C, D, E in all three groups were statistically significant. On comparison of three groups at all the five point statistically significant results were obtained. The current study shows that the discrepancy noticed at posterior palatal seal area in Group III (direct chair side reline) was less among all groups evaluated in this study. Whereas Group I (heat-polymerizing laboratory reline) is having the highest dimensional discrepancy, that is largest gap at palatal seal area at all pre decided five points. Group II showed less dimensional accuracy when compared to group III but was more when compared with Group I(control group). The distortion after the reline procedure displays more distortion at point C than at points A, E, B and D in posterior palatal seal area. Thus at mid-palatal region more distortion was noticed than either side of the ridges. (6, 14)

The result of present study is in accordance to the study conducted by **Y Kim, K Michalakakis and Hiroshi Hirayama** (15), who compared the dimensional accuracy between five different commonly used relining material and methods. He concluded that the chairside autopolymerizing method exhibited smaller gap recordings than the rest of the tested complete denture relining methods.

In the present study, no denture teeth were incorporated in the custom fabricated maxillary specimen dentures, which was also taken into consideration by **Barco et al** (16) (1979) who studied the effect of relining on the accuracy and stability of maxillary complete dentures and stated that increased distortion of heat cured denture bases with teeth was seen as compared to those without teeth. This phenomenon can be partially due to the thermal behavior of the acrylic resin below the glass transition temperature. As the teeth are held securely in the gypsum investment material and polymerized acrylic resin of the base locks the teeth. Thus, when thermal shrinkage of the acrylic resin occurs, the teeth are held firmly in place, which probably induces complex stresses in the denture base.

In the present study, it was found that, heat cure polymerizing relining material showed more discrepancy when compared to the other two direct chair side relining material, which is similar to the study done by **Anna Lucia et al** (17) (1996) who compared the dimensional stability of two chair side reline and one hard reline material. Measurements of the dimensions were made after processing and after the samples have been stored in distilled water at 37 degree for eight different interval of time. He concluded that there was no significant change seen with Lucitone 550 and Kooliner resin, whereas Duraliner exhibited increased dimensional shrinkage after a period of time. From the

following study, it can be very well concluded that the discrepancies produced after relining by the laboratory technique is more as compared to chair side relining technique, due to dual curing, polymerization shrinkage, relined stressed after deflasking causing warpage.

In the current study most amount of dimensional discrepancy in all the relining groups was observed at point C which is the midpalatal region at posterior palatal seal area. Similar results were also obtained in a study conducted by **Y Kim, K Michalakakis and Hiroshi Hirayama** (15) where he noticed a “W” type of discrepancy pattern at the posterior palatal seal area stating that discrepancy was observed at tuberosity and midpalatal region. whereas in the study done by Mendes JM, Silva AS, Aroso CM et al (16) (2016) who compared the dimensional changes of a thermally activated relining material (Paladon®65) with those of a self-activated relining material (Lucitone® and Palapress® Vario) across different thicknesses and different locations in the palatal area in several casts. In total, 60 relinings were performed, which included the preparation of 15 relining for each of the four different thicknesses of 1, 2, 3, and 4 mm. The goal was to produce 900 experimental units that could be measured in an inverted research metallurgical microscope. The self-polymerizing resin at thicknesses of 1 and 2 mm at point 3, which corresponds to the palate midpoint, achieved the best results. These results were contradictory to the results obtained in the present study. In study by Harvey et al on dimensional changes at the posterior border at the base plate made from visible light cure activated composite resin were attributed to polymerization, the cooling shrinkage after heat generated by the light curing unit, the composition of the resin or a combination of all the factors.

In current study one laboratory heat polymerizing resin (Lucitone) and two chair side relining materials (DPI cold cure and mollosil) are used. The amount of discrepancy produced at the posterior palatal seal area is maximum in heat polymerizing resin material when compared to the other two material. The result is in accordance with **Shivsagar Tewary** (18) (2014) who evaluated the linear dimensional accuracy of two chair side and two laboratory heat cure reline resin at three different time intervals after processing. He used a stainless steel split mol and 40 samples were fabricated by incorporating the split mold into first pour of denture flasks and packing each of the chairside reline resins “(Koolinerl and —Ufi Gel Hard)” and laboratory heat cure resins “(Dental Products of India Heat Curel and —Trevalon)”. The mean difference in dimensional change at 3 times intervals (0h, 4 days and 2 months) were calculated and subjected to statistical analysis. The study concluded that all resins showed different levels of significant shrinkage ($P < 0.001$) after processing (T0) ranging from -0.128 to -0.310 mm. After 4 days (T1), there was significant shrinkage ($P < 0.001$) ranging from -0.168 to -0.296 mm. After 2 months (T2), there was again significant shrinkage ($P < 0.001$) ranging from -0.018 to -0.216 mm. Chairside reline resins showed less dimensional shrinkage at each time interval than the laboratory heat cure resins. Hard chairside resins are dimensionally accurate than the laboratory heat cure resins.

In current study maximum amount of discrepancy was noted in group I (laboratory heat cure acrylic) at all the five points which was concluded to be the result of the different processing errors incorporated during the procedure of relining. The result of the present study is in accordance to **John Wolfdaart** (14) (1986) studied the influence of processing variables on dimensional changes of heat cure polymethyl methacrylate. The different variables he used were investment, separator, acrylic ratio, packing, pressure, curing rate and replication. The results of this study stated that dimensional changes taking place in the flask during the processing of heat-cured polymethyl methacrylate denture base resin are not uniform. The changes in dimension will vary according to the thickness of resin undergoing polymerization. The dimensional changes have a statistically significant relationship with the processing variables used in processing the denture base acrylic resin.

CONCLUSIONS:

1. The dimensional accuracy of relined maxillary specimen in posterior palatal seal area using heat cure acrylic resin was less compared to self cure acrylic resin.
2. The dimensional accuracy of relined maxillary specimen in posterior palatal seal area using heat cure acrylic resin (control group) was also less in comparison to the chair side self cure acrylic resin.

3. Chair side auto polymerizing resin demonstrated superior dimensional accuracy than all other relining methods when compared.
4. Point C (point present at centre of palate) showed maximum discrepancy than any other points in the relined maxillary specimen in posterior palatal seal area.

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