CHAPTER 4

RESULTS

4.1 Shear bond strength of denture base-reline polymer combinations

The mean shear bond strength values and the standard deviations of the seven denture base-reline polymer combinations are presented in Table 4.1 and diagrammatically in Figure 4.1. The result of one-way ANOVA (Table 4.2) showed there was a significant difference in the shear bond strength values among denture base-reline polymer combinations ($p<0.05$). Levene's test for equality of variance (Table 4.3) showed a significant departure from homogeneity of variances ($p<0.05$). Dunnett T3 post-hoc comparison was applied to test for the difference between denture base-reline polymer combinations. There were significant differences between denture base-reline polymer combinations, except for PMMA-Kooliner and UDMA-Meliodent RR polymer combinations.

The shear bond strength values ranged from 2.4±0.5 MPa to 14.5±0.5 MPa. Within PMMA denture base groups (Meliodent), the highest shear bond strength value was achieved with Meliodent RR reline materials (14.5±0.5 MPa), whilst for UDMA groups (Eclipse), the highest shear bond strength value was achieved with Eclipse relining (11.4±0.6 MPa). For all the three auto-polymerized reline materials (Meliodent RR, Secure and Kooliner) their shear bond strengths to PMMA were significantly higher than the strength of UDMA to the respective reline materials ($p<0.05$).

A comparison of shear bond strength values among PMMA denture base groups (Meliodent) showed that the lowest value was obtained when PMMA specimens were relined with Kooliner material (4.5±0.5 MPa). Similarly within UDMA denture base groups (Eclipse), the lowest shear bond strength value was shown with Kooliner material (2.4±0.5 MPa).

Two-way ANOVA result revealed that there were significant differences in the shear bond strength values as a function of the denture base polymer ($p<0.05$), and auto-polymerized reline materials ($p<0.05$), (Table 4.4). The interaction between denture

base polymer and reline material was also significant ($p<0.05$). The type of denture base polymer, reline material and their interaction affected the bond strength between them.

4.2 Mode of failure

The type and percentage of failure for various denture base-reline polymer combinations after the shear bond test was shown in Table 4.5. When PMMA denture base specimens were relined with Meliodent RR, 100% of the specimens showed cohesive failure within the denture base; while with Secure material, 100% of the specimens showed mixed failure; and with Kooliner reline materials, 100% of the specimens showed adhesive failure. However, for UDMA denture base groups, all denture base-reline polymer combinations showed 100% adhesive failure.

4.3 SEM findings

SEM observations of the UDMA and PMMA denture base surfaces after they were polished on the grinding machine using 600-grit silicone carbide paper were shown in Figure 4.2 (a) and Figure 4.2 (c) respectively. The views show scratches on the surfaces of the specimens as a result of grinding and polishing.

Figure 4.2 (b) is the SEM view of UDMA denture base surface after it was treated with Secure dichloromethane adhesive. The view shows the roughening effect of the denture base surface by the action of dichloromethane adhesive.

Figure 4.2 (d) is the SEM view of PMMA denture base surface after it was treated with dichloromethane adhesive. The view shows the appearance of a smooth surface with depressions. The effect of dichloromethane was to dissolve the surface layer of the PMMA specimens.

Figure 4.3 (a) is an SEM view of a representative of the bonding interface of UDMA denture base and Eclipse reline material after shear test. It showed an adhesive failure.

Figure 4.3 (b) showed the SEM view at a higher magnification (x 3000) of the adhesive failure.

Figure 4.4 (a) is an SEM view of a representative of the bonding interface of PMMA denture base and Secure reline material after shear test, showing a mixed failure. At higher magnification (x 3000) as in Figure 4.4 (b), the view showed remnants of Secure reline materials on the denture base surface, indicating a relatively strong bond between the two materials.

Table 4.1: Shear bond strength of PMMA & UDMA denture base polymers to various reline materials (mean values and S.Ds)

Denture Base Polymer	Reline Material	Bond Strength (MPa) Mean ± S.D	Significant difference
PMMA	**Meliodent R.R**	**14.5 ± 0.5**	**a**
	Secure	**9.9 ± 1.0**	**c**
	Kooliner	**4.5 ± 0.5**	**e**
	***Eclipse**	**-NA-**	**-**
UDMA	**Meliodent R.R**	**4.6 ± 0.7**	**e**
	Secure	**8.1 ± 0.7**	**d**
	Kooliner	**2.4 ± 0.5**	**f**
	Eclipse	**11.4 ± 0.6**	**b**

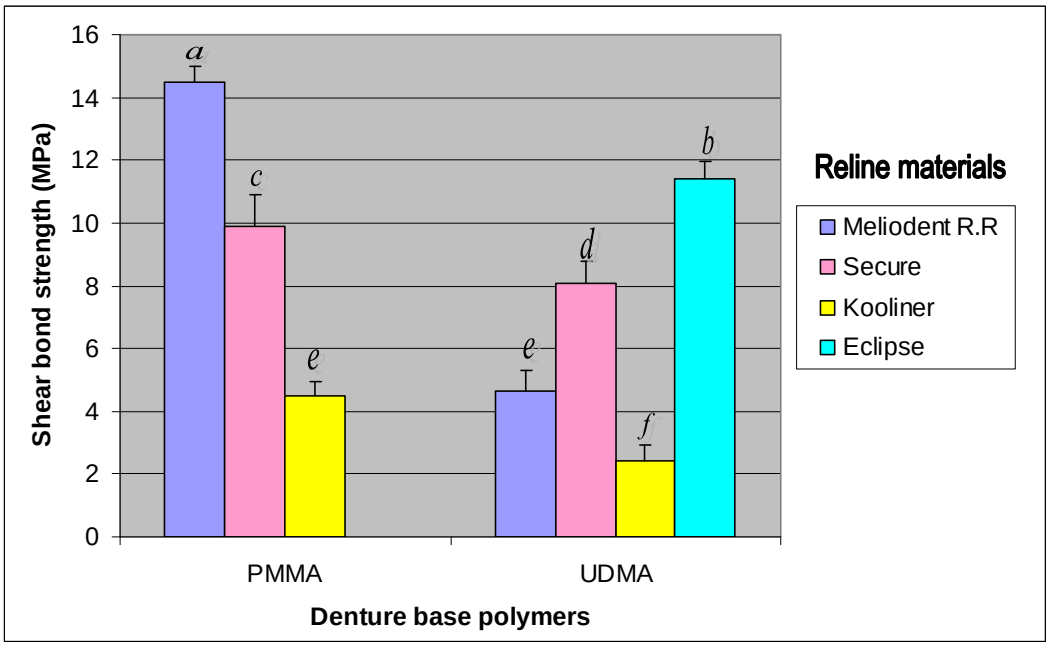
n =10

S.D = Standard deviation

* not possible to reline PMMA polymer with Eclipse material.

Same letter indicate values that were not statistically different using post-hoc Dunnett T3 test ($p>0.05$).

Figure 4.1: Shear bond strength of PMMA & UDMA denture base polymers to various reline materials (MPa)



One-way ANOVA showed a significant difference in shear bond strength of the denture base-reline polymer combinations ($p<0.05$).

Same letter indicate values that were not statistically different using post-hoc Dunnett T3 test ($p>0.05$).

Table 4.2: One-way ANOVA result for shear bond strength of seven denture base-reline polymer combinations.

Source of variation	SS	df	MS	F	Sig
Between	1121.602	6	186.934	437.787	.0001
combinations	26.901	63	0.427		
Within combinations	1148.503	69			
Total					

SS = Sum of square

Df = degree of freedom

MS = Mean square

Significant at p< 0.05

Table 4.3: Levene's test of homogeneity of variances

Levene Statistic	df1	df2	Sig.
2.258	6	63	0.049

Significant at p< 0.05.

Table 4.4: Two-way ANOVA result for shear bond strength of denture base polymers to auto-polymerized reline polymers.

Source of variation	SS	df	MS	F	Sig
Denture base polymer	313.685	1	313.685	702.85	.0001
Reline polymer	455.345	2	227.672	510.13	.0001
Denture base polymer x Reline polymer	210.203	2	105.101	235.49	.0001
Error	24.100	54	0.446		
Total	1003.333	59			

SS = Sum of square

Df = degree of freedom

MS = Mean square

Significant at p< 0.05

Table 4.5: Mode of failures for denture base-reline polymer combinations.

Denture Base Polymer	Reline Material	Type of failure (%)
PMMA	**Meliodent R.R**	**Cohesive (100 %)**
	Secure	**Mixed (100 %)**
	Kooliner	**Adhesive (100%)**
	***Eclipse**	**-NA-**
UDMA	**Meliodent R.R**	**Adhesive (100%)**
	Secure	**Adhesive (100%)**
	Kooliner	**Adhesive (100%)**
	Eclipse	**Adhesive (100%)**

* not possible to reline PMMA polymer with Eclipse material.

Figure 4.2: SEM observations of the UDMA and PMMA denture base surfaces.

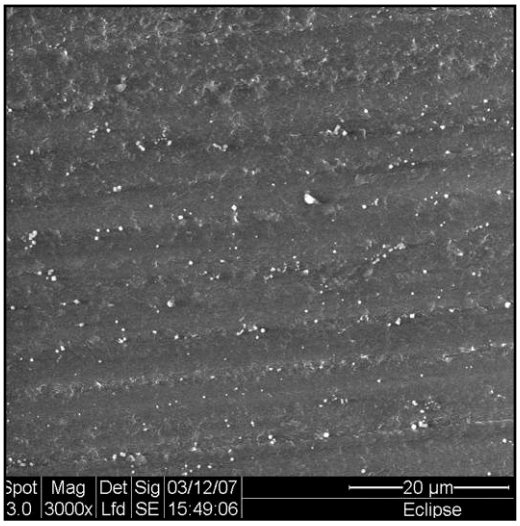


Fig. 4.2 (a). SEM view of the UDMA denture base surface after grinding with 600-grit silicone carbide paper (x 3000).

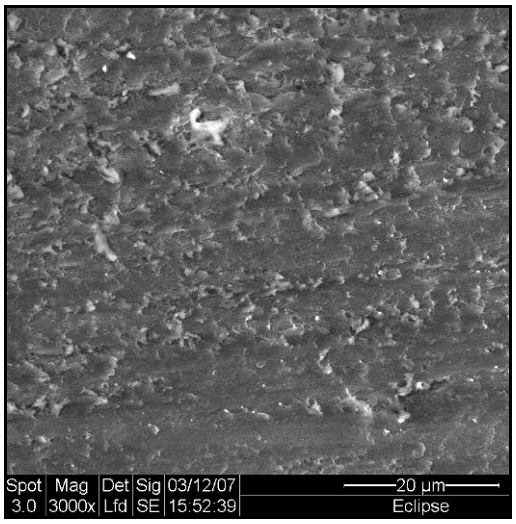


Fig. 4.2 (b). SEM view of UDMA denture base surface after treated with Secure dichloromethane adhesive (x 3000).

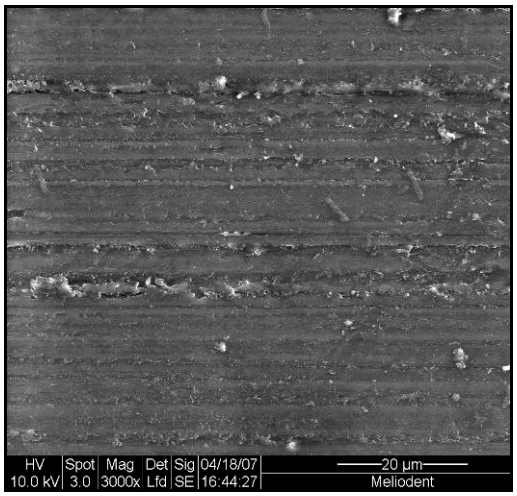


Fig. 4.2 (c). SEM view of the PMMA denture base surface after grinding with 600-grit silicone carbide paper (x 3000).

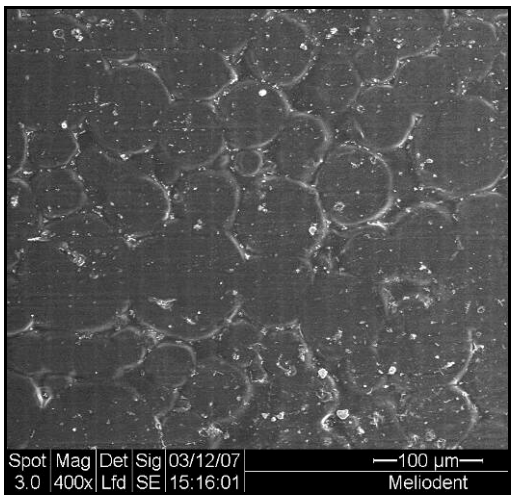


Fig. 4.2 (d). SEM view of PMMA denture base surface after treated with Secure dichloromethane adhesive (x 400).

Figure 4.3: SEM observations at the UDMA-Eclipse bonding interface after shear test.

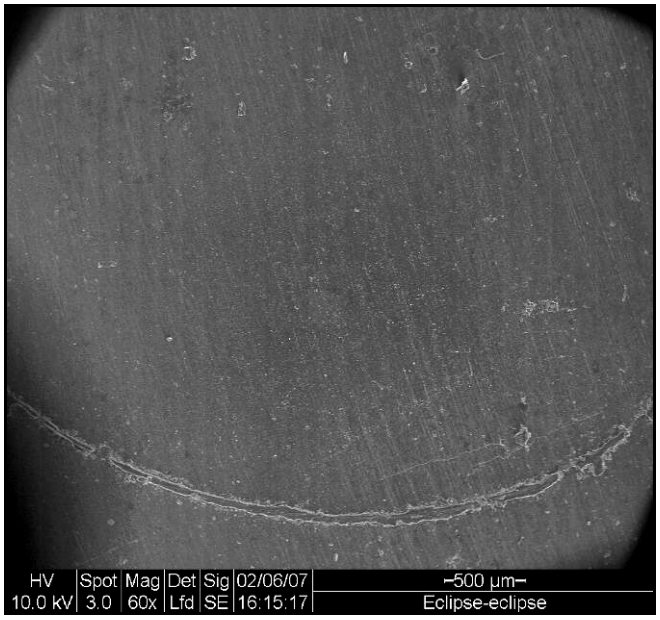


Fig. 4.3 (a). SEM view of UDMA specimen bonding surface after adhesive failure with Eclipse reline (x 60).

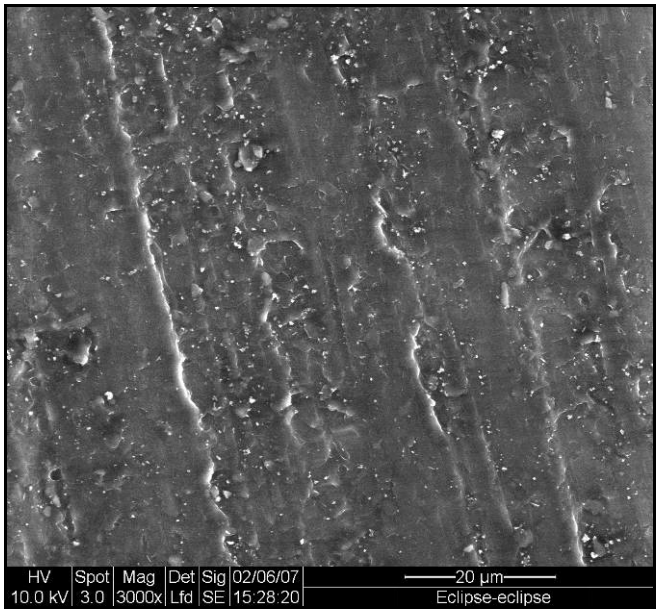


Fig. 4.3 (b). SEM view at higher magnification (x 3000) of Fig. 4.3 (a).

Figure 4.4: SEM observations at the PMMA-Secure bonding interface after shear test.

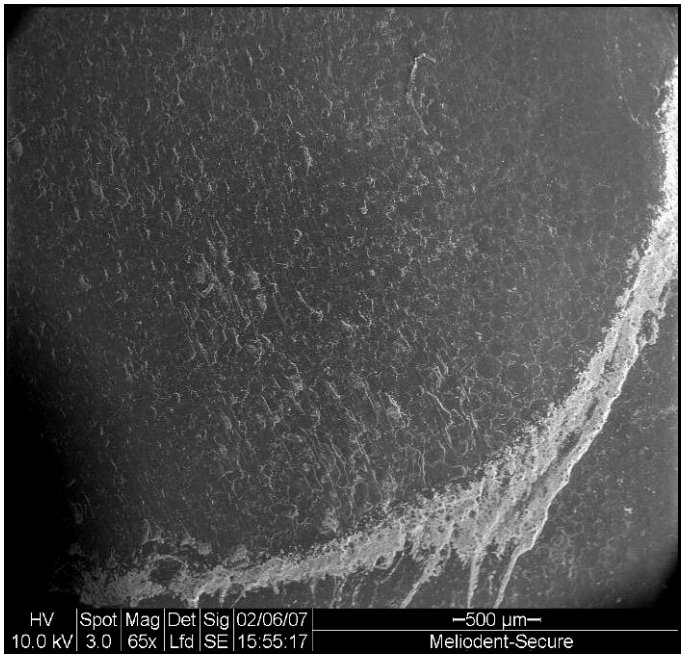


Fig. 4.4 (a). SEM view of PMMA-Secure bonding interface showing a mixed failure (x 65). Dichloromethane adhesive was applied prior to relining.

Fig. 4.4 (b). Higher magnification of the mixed failure (x 3000) showing remnants of Secure materials on the PMMA denture base surface (arrowed).