

CHAPTER IV

RESULTS

At enamel margin, tracer penetration data was provided in Table 2. Optibond FL groups showed the least leakage compared to Clearfil SE Bond and Clearfil S³ Bond groups. Similar results were found in modified protocol groups; modified Optibond FL showed the least leakage at enamel compared to modified Clearfil SE Bond and modified Clearfil S³ Bond groups.

Table 2 Microleakage scores at enamel margin among adhesive groups.

Group \ Enamel leakage	No leakage	no more than 1/3	no more than 2/3	more than 2/3	along axial wall
Optibond FL (OFL)	30	10	0	0	0
Clearfil SE Bond (CSE)	19	20	1	0	0
Clearfil S ³ Bond (C3S)	1	17	21	1	0
Modified Optibond FL (MOFL)	32	7	1	0	0
Modified Clearfil SE Bond (MSE)	23	5	8	0	0
Modified Clearfil S ³ Bond (M3S)	2	25	13	0	0

Distribution of microleakage scores at enamel margin was expressed as the number of teeth followed by the percentage in table 3. In the manufacturer's protocol groups, Optibond FL exhibited the highest percentage in low leakage score. Clearfil SE Bond and Clearfil S³ Bond exhibited more percentage in high leakage score than Optibond FL. In the modified protocol groups, modified Optibond FL exhibited the highest percentage in low leakage score. Modified Clearfil SE Bond showed more percentage in low leakage score than modified Clearfil S³ Bond.

Table 3 Distribution of enamel microleakage scores.

		Enamel leakage				Total
		No leakage	no more than 1/3	no more than 2/3	more than 2/3	
Optibond	Count	30	10	0	0	40
FL	% within group	75.0%	25.0%	.0%	.0%	100.0%
Clearfil SE	Count	19	20	1	0	40
Bond	% within group	47.5%	50.0%	2.5%	.0%	100.0%
Clearfil S ³	Count	1	17	21	1	40
Bond	% within group	2.5%	42.5%	52.5%	2.5%	100.0%
Modified	Count	32	7	1	0	40
Optibond	% within group	80.0%	17.5%	2.5%	.0%	100.0%
Modified	Count	23	5	8	0	36
Clearfil SE	% within group	63.9%	13.9%	22.2%	.0%	100.0%
Modified	Count	2	25	13	0	40
Clearfil S ³	% within group	5.0%	62.5%	32.5%	.0%	100.0%
Total	Count	107	84	44	1	236
	% within group	45.3%	35.6%	18.6%	.4%	100.0%

Statistical analysis was performed utilizing the Chi-Square test for determining a frequency distribution of microleakage scores among adhesive groups. The results were shown in table 4. The results demonstrated relationship between adhesive groups and microleakage score at enamel margin ($p=0.000$) indicating that degree of leakage was dependent on adhesive groups.

Table 4 Chi-Square test demonstrated relationship between adhesive groups and microleakage scores at enamel margins.

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	124.890 ^a	15	.000
Likelihood Ratio	147.086	15	.000
Fisher's Exact Test	138.691		
Linear-by-Linear Association	15.228 ^b	1	.000
N of valid cases	236		

- a. 6 cells (25.0%) have expected count less than 5. the minimum expected count is .15.
- b. The standardized statistic is 3.902.

At dentin margin, tracer penetration data was provided in table 5. All specimens exhibited microleakage. Clearfil SE Bond showed less leakage than Optibond FL and Clearfil S³ Bond. In contrast to manufacturer's protocol groups, the least leakage score was detected for Modified Optibond FL. Clearfil SE Bond and Clearfil S³ Bond exhibited higher leakage values.

Table 5 Microleakage scores at dentin margins among adhesive groups.

Group	Dentin leakage				
	No leakage	no more than 1/3	no more than 2/3	more than 2/3	along axial wall
Optibond FL (OFL)	0	22	17	1	0
Clearfil SE Bond (CSE)	0	37	3	0	0
Clearfil S ³ Bond (C3S)	0	29	11	0	0
Modified Optibond FL (MOFL)	0	36	0	0	0
Modified Clearfil SE Bond (MSE)	0	31	8	1	0
Modified Clearfil S ³ Bond (M3S)	0	23	13	1	3

The distribution of microleakage scores in dentin margin was expressed as the number of teeth followed by the percentage in table 6. In the manufacturer's protocol groups, Clearfil SE Bond exhibited the highest percentage in low leakage score. Optibond FL and Clearfil S³ Bond exhibited more percentage in high leakage score than Optibond FL. In the modified protocol groups, modified Optibond FL exhibited the highest percentage in low leakage score. Modified Clearfil SE Bond showed more percentage in low leakage score than modified Clearfil S³ Bond.

Table 6 Distribution of dentin microleakage scores.

		Dentin leakage				Total
		no more than 1/3	no more than 2/3	more than 2/3	along axial wall	
Optibond	Count	22	17	1	0	40
FL	% within group	55.0%	42.5%	2.5%	.0%	100.0%
Clearfil SE	Count	37	3	0	0	40
Bond	% within group	92.5%	7.5%	.0%	.0%	100.0%
Clearfil S ³	Count	29	11	0	0	40
Bond	% within group	72.5%	27.5%	.0%	.0%	100.0%
Modified	Count	36	0	0	0	36
Optibond	% within group	100.0%	.0%	.0%	.0%	100.0%
Modified	Count	31	8	1	0	40
Clearfil SE	% within group	77.5%	20.0%	2.5%	.0%	100.0%
Modified	Count	23	13	1	3	40
Clearfil S ³	% within group	57.5%	32.5%	2.5%	7.5%	100.0%
Total	Count	178	52	3	3	236
	% within group	75.4%	22.0%	1.3%	1.3%	100.0%

Statistical analysis was performed utilizing the Chi-Square test for determining a frequency distribution of microleakage scores among adhesive groups. The results were shown in table 7. The results demonstrated relationship between adhesive groups and microleakage score at dentin margin ($p=0.000$) indicating that degree of leakage was dependent on adhesive groups.

Table 7 Chi-Square test demonstrated relationship between adhesive groups and microleakage scores at dentin margins.

	Value	df	Asymp.Sig. (2-sided)
Pearson Chi-Square	47.990 ^c	15	.000
Likelihood Ratio	52.432	15	.000
Fisher's Exact Test	43.776		
Linear-by-Linear Association	1.525 ^d	1	.217
N of valid Cases	236		

- c. 12 cells (50.0%) have expected count less than 5. the minimum expected count is .46.
d. The standardized statistic is 1.235.

Comparison of the microleakage scores between enamel and dentin margins for Optibond FL and modified Optibond FL are shown in table 8. Wilcoxon Signed Rank test showed that Optibond FL and modified Optibond FL exhibited significantly more leakage in dentin ($p= 0.000$). When comparing adhesives which were used according to the manufacturers' instructions and adhesives which were applied following modified protocol, modified Optibond FL presented less leakage at dentin margin than Optibond FL significantly ($p= 0.020$), and no statistically difference at enamel margin was found ($p= 0.763$).

Table 8 Wilcoxon Signed Rank test demonstrated comparison of enamel and dentin leakage scores for Optibond FL and modified Optibond FL.

	OFL dentin leakage - OFL enamel leakage	MOFL dentin leakage - MOFL enamel leakage	MOFL enamel leakage - OFL enamel leakage	MOFL dentin leakage - OFL dentin leakage
Z	-5.476 ^(a)	-5.014 ^(a)	-.302 ^(b)	-2.333 ^(b)
Asymp. Sig. (2-tailed)	.000	.000	.763	.020

a Based on negative ranks.

b Based on positive ranks.

Comparison of microleakage scores between enamel and dentin margins for Clearfil SE Bond and modified Clearfil SE Bond are shown in table 9. Wilcoxon Signed Rank test showed that Clearfil SE Bond, modified Clearfil SE Bond exhibited significantly more leakage in dentin ($p= 0.000$) compared to enamel. When comparing adhesives which were applied according to the manufacturers' instructions and adhesives which were applied following modified protocol, Clearfil SE Bond and modified Clearfil SE Bond exhibited no significant difference in leakage score both in enamel ($p= 0.864$) and dentin margins ($p= 0.071$).

Table 9 Wilcoxon Signed Rank test demonstrated comparison of enamel and dentin leakage scores for Clearfil SE Bond and modified Clearfil SE Bond

	CSE dentin leakage - CSE enamel leakage	MSE dentin leakage - MSE enamel leakage	MSE enamel leakage - CSE enamel leakage	MSE dentin leakage - CSE dentin leakage
Z	-4.031 ^(a)	-4.642 ^(a)	-.172 ^(b)	-1.807 ^(a)
Asymp. Sig. (2-tailed)	.000	.000	.864	.071

a Based on negative ranks.

b Based on positive ranks.

Comparison of microleakage scores between enamel and dentin margins Clearfil S³ Bond and modified Clearfil S³ Bond are shown in table 10. Wilcoxon Signed Rank test showed that modified Clearfil S³ Bond exhibited significantly more leakage in dentin ($p= 0.035$) while Clearfil S³ Bond exhibited a similar performance in both substrates ($p= 0.467$). When comparing adhesive which were applied following the manufacturer's instruction and adhesive which were applied following modified protocol, modified Clearfil S³ Bond shown less leakage at enamel margin than Clearfil S³ Bond significantly ($p= 0.000$), but no significant difference at dentin margin ($p= 0.231$).

Table 10 Wilcoxon Signed Rank test demonstrated comparison of enamel and dentin leakage scores for Clearfil S³ Bond and modified Clearfil S³ Bond

	C3S dentin leakage - C3S enamel leakage	M3S dentin leakage - M3S enamel leakage	M3S enamel leakage - C3S enamel leakage	M3S dentin leakage - C3S dentin leakage
Z	-.728 ^(a)	-2.114 ^(b)	-4.185 ^(a)	-1.199 ^(a)
Asymp. Sig. (2-tailed)	.467	.035	.000	.231

a Based on positive ranks.

b Based on negative ranks.

Comparison of microleakage scores at enamel margin between adhesive groups are shown in table 11. Wilcoxon Signed Rank test showed significantly less leakage for Optibond FL compared with Clearfil SE Bond ($p= 0.011$), Clearfil S³ Bond ($p= 0.000$), modified Clearfil SE Bond ($p= 0.040$) and modified Clearfil S³ Bond ($p= 0.000$).

Table 11 Wilcoxon Signed Rank test demonstrated comparison of enamel leakage scores between adhesive groups.

	CSE enamel leakage - OFL enamel leakage	C3S enamel leakage - OFL enamel leakage	MSE enamel leakage - OFL enamel leakage	M3S enamel leakage - OFL enamel leakage
Z	-2.558 ^(a)	-5.690 ^(a)	-2.049 ^(a)	-5.304 ^(a)
Asymp. Sig. (2-tailed)	.011	.000	.040	.000

a Based on negative ranks.

b Based on positive ranks.

Comparison of microleakage scores at dentin margin between adhesive groups are shown in table 12. Clearfil SE Bond exhibited significantly less leakage when compared to Clearfil S³ Bond ($p= 0.000$) and modified Clearfil S³ Bond ($p= 0.001$). No significant difference in leakage scores was found when compared Clearfil SE Bond to Optibond FL ($p= 0.132$) and modified Optibond FL ($p= 0.083$).

Table 12 Wilcoxon Signed Rank test demonstrated comparison of dentin leakage scores of Clearfil SE Bond group and other adhesive groups.

	CSE dentin leakage - OFL dentin leakage	C3S dentin leakage - CSE dentin leakage	MOFL dentin leakage - CSE dentin leakage	M3S dentin leakage - CSE dentin leakage
Z	-1.508 ^(b)	-4.914 ^(a)	-1.732 ^(b)	-3.473 ^(a)
Asymp. Sig. (2-tailed)	.132	.000	.083	.001

a Based on negative ranks.

b Based on positive ranks.

Comparison of microleakage scores at dentin margin between modified Optibond FL and other adhesives are showed in table 13. Modified Optibond FL exhibited significantly less leakage compared with Clearfil S³ Bond ($p= 0.000$), modified Clearfil SE Bond ($p= 0.004$) and modified Clearfil S³ Bond ($p= 0.001$). But no significant difference between modified Optibond FL and Clearfil SE Bond ($p= 0.083$).

Table 13 Wilcoxon Signed Rank test demonstrated comparison of dentin leakage scores of modified Optibond FL group and other adhesive groups.

	MOFL dentin leakage - CSE dentin leakage	MOFL dentin leakage - C3S dentin leakage	MSE dentin leakage - MOFL dentin leakage	M3S dentin leakage - MOFL dentin leakage
Z	-1.732 ^(a)	-5.000 ^(a)	-2.887 ^(b)	-3.307 ^(b)
Asymp. Sig. (2-tailed)	.083	.000	.004	.001

a Based on positive ranks.

b Based on negative ranks.

Representative of microleakage scores along enamel and dentin margin are shown in Figure 7 and Figure 8. In the present study, it was noted that leakage of silver nitrate did not occur right at enamel-resin interface, but originating from outer surface of enamel margins as shown in Figure 9. Enamel leakage from outer surface was observed in the majority of specimens. At dentin margin, silver nitrate penetrated into dentinal tubules along the dentin surface that was not sealed with nail varnish (Figure 10).

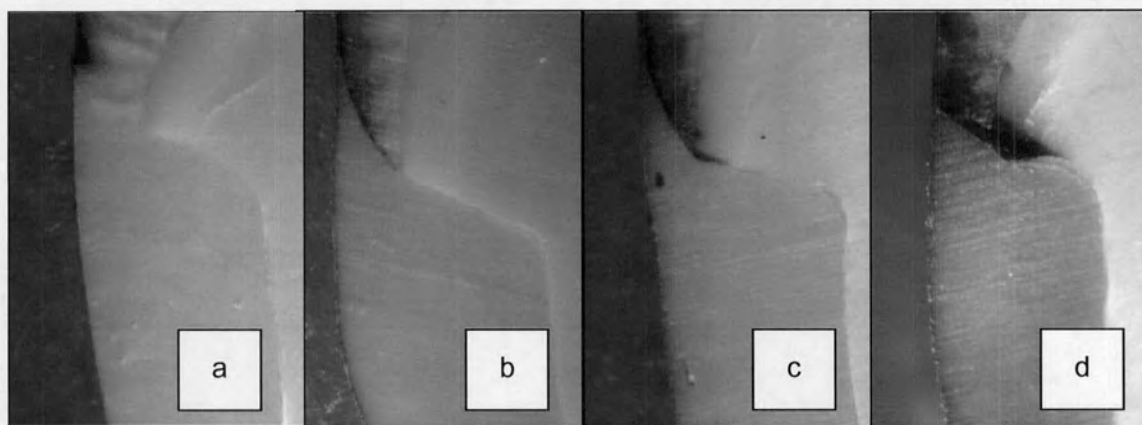


Figure 7 representative of microleakage score along enamel margin (a) showed leakage score = 0, (b) showed leakage score = 1, (c) showed leakage score = 2, (d) showed leakage score = 3.

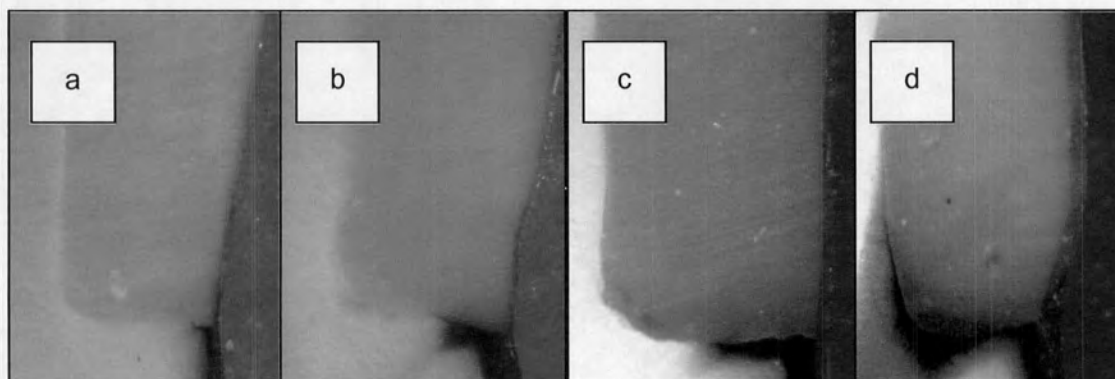


Figure 8 representative of microleakage score along dentin margin (a) showed leakage score = 1, (b) showed leakage score = 2, (c) showed leakage score = 3, (d) showed leakage score = 4.



Figure 9 Example of penetration of silver nitrate along enamel margin, showing the possibility of origin of silver nitrate penetration being from microcrack in enamel structure.

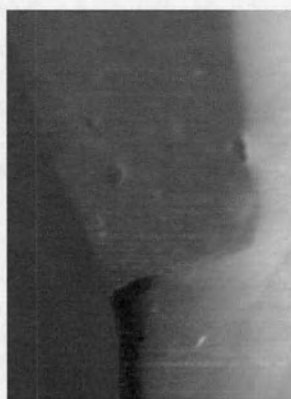


Figure 10 Example of penetration of silver nitrate along dentin margin, showing the possibility of origin of silver nitrate penetration being from exposed cementum.