Short Communication

Effect of 20- or 60-second curing times on retention of five sealant materials

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For adequate sealant retention, the bonding surface area must be maximized and the enamel clean, free of salivary contamination, and dry at the time of sealant placement.[1,2] However, because pit and fissure sealants bond to the cuspal incline planes and not to the bottoms of the pits and fissures,[3-6] insufficient curing of the resin sealant could reduce the bond strength.

The purpose of this study was to compare the shear bond strength to enamel of filled (PrismaShield™ and FluroShield™) and unfilled (Helioseal™, Delton™, and Concise™) sealants light-cured for different times.

Methods and materials

Eighty noncarious extracted human permanent molars stored in distilled water were used. The buccal and lingual enamel surfaces were ground flat with 600 grit SiC paper to provide uniform surfaces to which the sealant could be applied. Care was taken not to expose the dentin.

The teeth were acid-etched with 37% phosphoric acid gel (Ivoclar/Vivadent, Schaan,Liechtenstein) for 30 sec, rinsed with distilled water for 20 sec and dried with oil-free compressed air for another 20 sec. The teeth were then distributed randomly into 10 groups of eight teeth (16 surfaces) each:

- Group 1: Helioseal (Ivoclar/Vivadent, Schaan, Liechtenstein) 20-sec cure
- Group 2: Helioseal, 60-sec cure
- Group 3: Delton (LD Caulk Co, Milford, DE) 20-sec cure
- Group 4: Delton, 60-sec cure
- Group 5: Concise Light Cure, (3M Co, St Paul, MN) 20-sec cure
- Group 6: Concise Light Cure, 60-sec cure
- Group 7: PrismaShield, (LD Caulk Co, Milford, DE) 20-sec cure
- Group 8: PrismaShield, 60-sec cure
- Group 9: FluroShield, (LD Caulk Co, Milford, DE) 20-sec cure
- Group 10: FluroShield, 60-sec cure

A plastic cylinder (surface area 5.25 mm^2) was placed over the etched enamel and secured with white sticky wax. The sealant was placed into the rings and cured for the specified times from the side of the cylinder. Immediately after curing, the specimens were immersed in distilled water for 24 hr and then thermocycled for 500 cycles in distilled water at 5°C and 55°C with a 30-sec dwell time. Immediately, the specimens were mounted in plastic cups with dental stone and sheared with a knife-edged blade in a Universal Testing Machine™ (Instron Engineering Corp, Canton, MA) running at a crosshead speed of 0.5 mm/min. Results were recorded in Newtons, and the megapascal (MPa) values were calculated using the surface area of the cylinder. After shearing the specimens, each tooth and composite interface was examined visually and with the SEM to record the failure mode. The ANOVA (at $P < 0.01$) and the Student-Newman-Keuls procedure (at $P < 0.05$) were used to evaluate the results.

Results

The results are presented in the table. ANOVA and Student-Newman-Keuls tests showed no statistically significant difference between either the curing times or the sealant type (filled or unfilled). With the unfilled sealant, as the curing time increased, sealant cohesive failures increased, while with the filled sealants, as the curing time increased, the enamel cohesive strengths increased.

Discussion

The lack of enamel wettability, lack of penetration of the sealant into enamel, and a deep uncured sealant layer could contribute to a low sealant retention rate. Therefore, the use of a longer curing time to increase sealant retention seems appropriate. The longer curing time produced a higher sealant cohesive failure rate with the unfilled sealants than the shorter curing time and a higher enamel cohesive failure rate with the filled sealants. This could mean that a longer curing time

TABLE. SHEAR BOND STRENGTHS FOR THE DIFFERENT GROUPS

Group	Mean (MPa)	SD	Range	Failure Site: Enamel Cohesive	Sealant Cohesive	Adhesive
Helioseal™						
20 s cure	18.74	8.10	2.99–24.36	6/16	8/16	2/16
60 s cure*	18.17	6.59	3.74–26.91	1/15	10/15	4/15
Delton™						
20 s cure	14.59	7.38	2.99–24.36	1/16	7/16	8/16
60 s cure	13.33	5.96	3.74–26.91	1/16	9/16	6/16
Concise Light Cure™						
20 s cure	16.50	6.21	2.99–24.36	6/16	6/16	4/16
60 s cure	16.30	5.32	3.74–26.91	2/16	9/16	5/16
PrismaShield™						
20 s cure	20.02	6.03	3.74–26.91	2/16	10/16	4/16
60 s cure	16.65	4.72	3.74–26.91	6/16	8/16	1/16
FluroShield™						
20 s cure	15.46	5.33	4.48–22.87	3/16	9/16	4/16
60 s cure	20.80	7.93	5.98–28.40	7/16	8/16	1/16

* One sample lost during specimen preparation.

might produce a stronger enamel-sealant unit which could be more wear-resistant in the clinical environment. Strang et al.[7] reported that a 60-sec light curing was needed to ensure complete curing for all possible combinations of sealants and lights they tested. They suggested using the longer exposure time of 60 sec rather than risking the possibility of early loss of sealant due to poor bonding resulting from inadequate exposure or a defective light source.

Differences in sealant retention have been explained by the clinical conditions under which they are placed, the age of the children involved, and the personnel placing sealants.[8] Filled sealants have been shown, in vitro[9] and in vivo,[10] to be more wear-resistant than unfilled sealants with the unfilled sealants wearing about twice as fast as the filled sealants. One clinical study[11] comparing light-cured clear Delton with the tinted PrismaShield, reported the former to have significantly better clinical results after 3 years than the latter. Another study[8] reported that the filled PrismaShield sealant was not superior to the unfilled Concise sealant, displaying equal clinical performance on occlusal retention.

Park et al.[12] reported that most failures in the FluroShield group were recorded as enamel cohesive failures while PrismaShield exhibited a combination of enamel fractures and adhesive fractures, and a combination of adhesive and cohesive fractures. No enamel fractures were observed with Delton, but only adhesive and sealant cohesive failures were reported. In our study, all sealants displayed some enamel cohesive failures with no clear trend established for filled or unfilled sealants.

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