Radiopacity Of Dental Adhesives: A Comparative Study

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Introduction:

Adhesion to tooth structure has been a subject of considerable research interest for many decades [1], being adhesion to enamel and then bonding to dentin one of the most significant advances in dentistry in the past 50 years.[2]
In a radiograph it is possible to safely distinguish carious lesions from simple pigmented margins, as the appearance of secondary caries leads to rapid demineralization of the tissues causing a dark halo around the lesion cavity.[3] The radiopacity in dental materials should be sufficient for a clear location of the interface between them and the surrounding anatomic structures.[3,4,5,6,7,8]

Objectives:

To evaluate the radiopacity of 10 popular adhesive systems and compare them with healthy and decayed human enamel and dentin. The null hypothesis is that there is no difference in radiopacity between the adhesive systems, and sound enamel and dentin.

Methods:

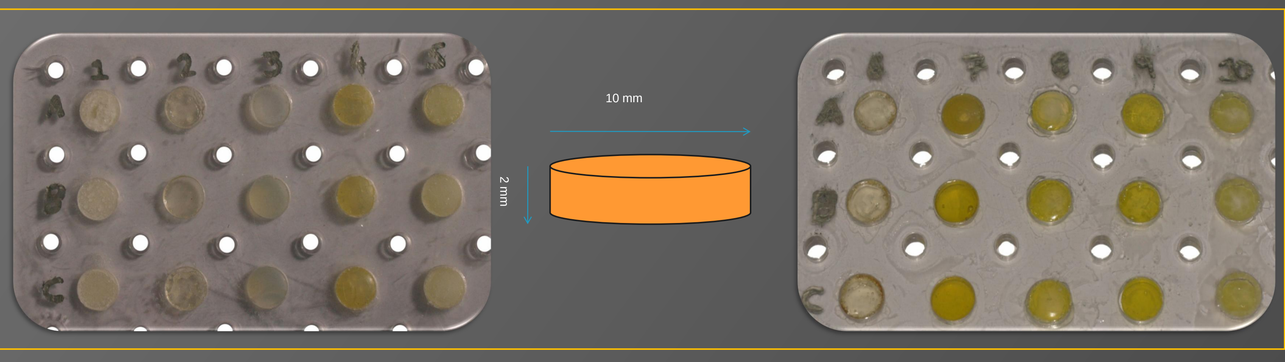

Fig. 1

Fig. 2

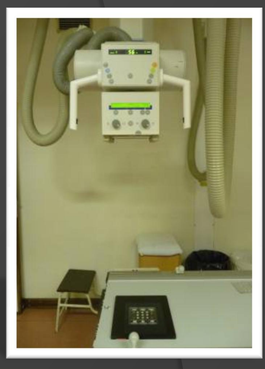

Fig. 3

1. Samples of ten adhesive systems were used: A.R.T.Bond (ART), One Coat ™ Bond (OCB), One Coat™ 7.0 (OC7) and One Coat ™ Self-etching Bond (OCS) from Coltène Whaledent (Ohio, USA); Adper ™ Scotchbond ™ Multi-purpose Adhesive (ASM), Adper ™ Scotchbond ™ 1XT Adhesive (AS1XT), Adper ™ Scotchbond ™ SE (ASSE) and Adper ™ Easy Bond (AEB) from 3M-ESPE (Minnesota, USA); Optibond ™ FL (OFL) and Optibond ™ All-in-One (OAO) from Kerr (Orange, USA). All specimens (n=30) (10mm diameter and 2mm thickness) were prepared according to manufacturer's instructions. (Fig. 1)

2. Three healthy human teeth, including enamel and dentin, and three decayed human teeth were sectioned lengthwise (2mm thickness). (Fig. 2)

3. Samples were stored at room temperature (± 22°C).

4. Radiographs were taken with the X-Ray equipment Multix (Siemens - Munich, Germany) (default values: 42 kV, 3.6 MAS, 110cm FFD (focus-film distance)) (Fig. 3) and digitized by a scanner Agfa ADC Compact Plus (Mortsel, Belgium). Radiographs were printed in a digital film Agfa CR MD4.0 General (Mortsel, Belgium). (Fig. 4)

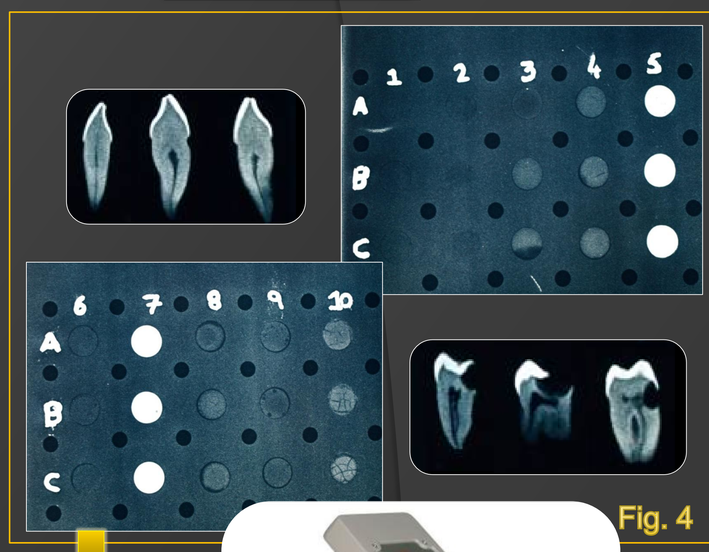

Fig. 4

5. Optical densities (ODU) of adhesive systems, enamel, dentin and decay lesions were measured, using the transmission densitometer 331 (X-rite - Grandville, USA). With three readings per specimen, nine readings per adhesive were obtained.[5] (Fig. 5) The average and SD were then calculated. Radiodensity data (optical density unit - ODU) were statistically analyzed using Kruskal-Wallis test followed by *post-hoc* paired comparisons.

Fig. 5

Results and Discussion:

Fig. 6

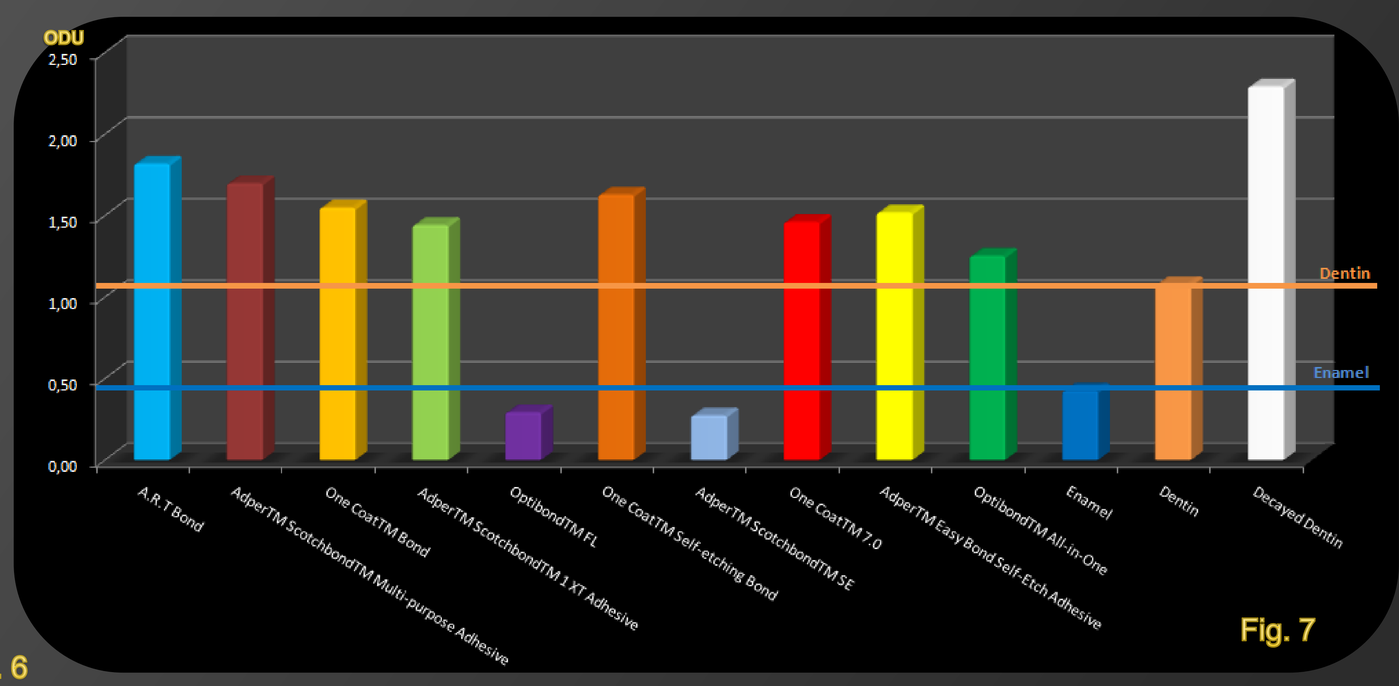

Fig. 7

Results obtained in this research showed a great variation depending on the adhesive system, with values ranging between 0,27±0,03 ODU and 1,82±0,06 ODU (an higher numerical value corresponds to a lower radiopacity.) (Fig. 6 e 7).
Ideally, dental materials should be radiopaque.[4,5,6] In this study, all the materials tested showed some degree of radiopacity; nevertheless, this may not be sufficient to make a correct differential diagnosis with secondary caries. Most of the analyzed adhesive systems could even be considered radiolucent.

ASSE and OFL showed the highest values of radiopacity, significantly different from enamel, dentin and caries lesions. ($p < 0,05$, Kruskal-Wallis and *post hoc* paired comparison).[9]
OAO showed a statisticaly significant difference with decayed dentin , but there was no difference when compared with enamel and dentin, which means a quite satisfactory radiopacity that will allow a correct diagnosis ($p < 0,05$, Kruskal-Wallis and *post hoc* paired comparison).[9]
ART and OCS didn't show a significant difference when compared with decayed dentin ($p < 0,05$, Kruskal-Wallis and *post hoc* paired comparison).[9.]
There have been few studies that relate radiopacity and adhesive systems.[3,4,5] Given the extreme relevance of this property in the differential diagnosis of secondary caries, more research is needed in this area.

Conclusions:

According to the results obtained and the limitations of this study, it can be concluded that:
1. The null hypothesis should be rejected. There are significant differences between the radiopacity values of the ten adhesive systems tested, sound enamel and dentin.
2. Only Optibond™ FL and Adper™ Scotchbond™ SE had a radiopacity higher than that of sound dental structures: enamel and dentin, thus allowing a more accurate differential diagnosis with secondary caries lesions.
3. All other adhesive systems of "etch and rinse" and "self-etch" systems were less radiopaque than sound dentin and enamel.
4. Systems ART Bond and One Coat™ Self-etching Bond did not show a significant difference with decay lesions.

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