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SEAL DEVELOPMENT AND COMPOSITION AT AMALGAM-CERAMIC INTERFACES AFTER NaCl AND Na_2S STORAGE

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Chlorine and sulphur have been found in the marginal seal of some tooth-amalgam interfaces[1]. Although the role of Cl in the sealing process is relatively well established the role of S remains more obscure. The purpose of the present study was to compare the sealing properties and elemental composition of the seal formed at the interface of amalgams placed in ceramic cavities and stored in either a 10% NaCl or 10% Na_2S aqueous solution. This investigation undertaken in a simple controlled environment, devoid of complex oral influences, would clarify the role that these two elements play in the sealing process at amalgam-tooth interfaces within the mouth.

Fifty-eight cavities, each of 3mm diameter and approximately 4,5mm deep, were machine prepared in ceramic blocks . Half of the cavities were obturated with a conventional dental amalgam, while the remaining cavities were restored with a disperse phase dental amalgam. From each amalgam group, three restorations were stored in air (controls), 13 were stored in 10% aqueous NaCl, and the remaining 13 in 10% aqueous Na_2S solution. After a storage period of three months at room temperature (<20°C), the NaCl and Na_2S specimens were briefly rinsed three times in double distilled water before being air dried. Subsequently forty of these cavities (10 per amalgam group) were subjected to a marginal leakage fluorescent dye test[2], sectioned and scored for marginal leakage as previously described[2]. The three air, three NaCl and three Na_2S stored specimens which remained from each amalgam group were partially sectioned with a low speed, water cooled, diamond blade rotary saw to facilitate fractures through the ceramic material and so expose the amalgams. The condensed amalgam surface and the empty cavity walls were then lightly coated with high purity carbon and examined at 20kV in a JSM-840 scanning electron microscope equipped with a Link AN10000 energy dispersive X-ray analyzer . X-ray analysis was carried out on both the amalgam surface which had been condensed against the cavity wall and on the cavity wall itself. Reference X-ray energy dispersive spectra were obtained by analysing fractured specimens of both types of condensed amalgam specimens and the surface of the ceramic material. Analysis conditions were a live counting time of 100 seconds and a count rate adjusted to 2500 per second. All analyses were undertaken twice on different areas of each of the specimens using an area scan mode in order to encompass as large a sample surface as possible. The elemental composition was normalised at 100%.

The leakage experiment showed that 10% of the conventional and 20% of the disperse phase amalgams stored in the Na_2S solution formed seals, whereas 50% of the conventional amalgams and 90% of the disperse phase amalgams stored in the NaCl solution showed sealing properties. The seal material of the control condensed amalgam surfaces showed only the elements which were present in the respective amalgams together with trace amounts of Al, Mg and Si which originated from the ceramic blocks. The empty walls of the cavities of this control group were composed of mainly Al, K, Mg and Si, consistent with the reference spectrum obtained for the ceramics with trace amounts of Hg. The conventional amalgams stored in NaCl had a thick corrosion layer consisting mainly of Sn and Cl with smaller amounts of Si, Al and Mg. The disperse phase amalgams showed a similar Sn and Cl pattern, but small amounts of Ag, Al, Hg, Mg, Si and traces of Cu were also detected. The empty ceramic cavity walls of both amalgam types stored in NaCl showed an element pattern consistent with the control specimens, but both groups also contained similar quantities of Cl and Sn and trace amounts of Cu. X-ray analysis revealed that Ag and Hg were the major elements present in the surface seal layer on the conventional amalgam stored in Na_2S with trace amounts of Na, S and Sn. The disperse phase alloy stored in Na_2S showed elevated Cu and depressed Sn concentrations together with trace amounts of Al, Mg, S and Si compared to the control. Examination of the empty cavity walls of the ceramic from the specimens stored in Na_2S showed that in addition to the elements specific to the ceramic, both specimens contained small amounts of Ag, Cu, Na and S.

These results support the finding that the corrosion behaviour of dental amalgams can be affected by NaCl and Na_2S[3] and that this also affects the products that form at amalgam-cavity interfaces. Amalgams in the presence of NaCl are able to form a seal without interacting with a natural tooth cavity interface, whereas the marginal leakage results of the Na_2S treated specimens show that the corrosion products formed under the conditions of this experiment did not play as significant a role in seal formation. Further work is necessary to evaluate the presence and role of S at amalgam-cavity wal interfaces.

References

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