Abstract

A number of distinctive dental porcelain-fused-to-metal (PFM) crown artefacts were received by the authors. It was suspected that these crowns had been immersed in hydrochloric acid for seven days. One of the authors (AF) was asked if this could be demonstrated.

A sample of the same metal used for casting the crown copings was received from the laboratory that manufactured the original crowns and this was examined by the authors (AF and PH) using scanning electron microscopy (SEM) and EDS (Electron Dispersive Spectroscopy).

Subsequently the sample of metal was immersed in the same brand of hydrochloric acid in which the original crowns were alleged to have been immersed, and for the same time period (seven days). It was then re-examined by SEM and EDS to determine what changes had occurred.

SEM examination of the original crowns was then undertaken and similar features to those observed in the sample of metal were observed, and the component elements of the crown metal were verified as being similar to that of the sample. We concluded that the original crowns had been immersed in a corrosive substance, although this test did not identify the specific identity of the corrosive.

Introduction

A number of dental porcelain-fused-to-metal (PFM) crowns (the Original Crowns) were submitted to the authors for analysis. The authors were informed that it was suspected that these items had been immersed in hydrochloric acid (HCl) for seven days, and we were asked if we could confirm that. Perusal of the literature revealed no publications that documented the changes in appearance of materials commonly used in dental crown and bridge fabrication after prolonged exposure to HCl. We therefore tested the outcome by experimentally immersing a Test Bridge made by the same dental laboratory using the same materials, and compared the changes noted in the Test Bridge surfaces with the surfaces of the Original Crowns.

Material and Methods

A sample Test Bridge made by the same dental laboratory as the submitted (original) crowns was obtained (figure 1 (a)) and both the metal and porcelain parts were examined under a Scanning Electron Microscope (SEM) (area shown in figure 1(b)).

The elemental composition of the metal component of both the Test Bridge and the Original Crown was determined by EDS (Electron Dispersive Spectroscopy) as shown in figure 2 (a) and (b), which shows that the principal components were nickel (Ni) and chromium (Cr) and both items were fabricated using a similar metal.

The original appearance of the metal surface of the Test Bridge is shown in figure 3(a). The Test Bridge was then immersed in the same brand and concentration of HCl that we were told had been used for the original crowns and for the same period (seven days). The same area of the Test Bridge was then re-examined to determine the effect of the HCl. Changes consistent with corrosion were observed in the metal as shown in figure 3(b).

The porcelain component of the Test Bridge was also examined before and after immersion in the HCl, and the resulting SEM scans are shown in figures 4(a) and 4(b).

The Original Crowns were then examined and the SEM scans are shown in figure 5(a) and figure 5(b). The appearance of the metal and porcelain surfaces in the Original Crowns can be seen to show the same features as those seen in the Test Bridge after exposure to HCl for seven days.

Results and Conclusion

This project aimed to determine and document the changes occurring in dental crown and bridge metal and ceramic materials caused by immersing them in HCl for seven days. When the resulting changes were compared with the features noted in the Original Crowns, they were found to be very similar, indicating the likelihood that the Original Crowns had also been immersed in a similar corrosive.

The identity of the specific corrosive in which the Original Crowns were immersed has not, however, been identified by this technique, because EDS did not demonstrate Chlorine or any other substance indicating a corrosive as a surface component of the materials being examined.

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