F26 Implications of Composite Resin Radiopacity During Dental Inspection

Raymond G. Miller, DDS, Mary A. Bush, DDS, and Peter J. Bush, BS, State University of New York at Buffalo, South Campus Instrument Center, School of Dental Medicine, B1 Squire Hall, South Campus, SUNY at Buffalo, Buffalo, NY 14214*

After attending this presentation, attendees will gain knowledge of the variation in radiopacity of restorative resins. Their radiographic appearance in tooth structure will be discussed, and the potential for missing restorations during inspection will be assessed.

This presentation will impact the forensic community and/or humanity providing the forensic odontologist with a survey of the radiographic qualities of restorative resins, both historical and modern. This, along with preparation design is of significance because the ability to recognize restorations during dental inspection is dependent on the radiopacity, size, and location of the restoration.

Victim identification through dental record comparison relies substantially on radiographic evidence. Both clinical and forensic interpretation of a radiograph may involve distinguishing subtle differences in contrast and brightness in the image. Those small differences can reveal to the trained eye the presence of carious lesions, resin restorations or features such as veneers.

The combination of novel materials on the market and the trend towards esthetic restorations has resulted in placement of restorations that may be hard to detect both visually and radiographically. Since the inception of composite resins as restorative materials, their composition has undergone generational changes. Manufacturers have modified the composition of the resins for several reasons including shrinkage, handling characteristics, wear resistance, esthetics, and not least, radiopacity. Early resins used silica as inorganic filler, resulting in restorations that appeared radiolucent. Today most (but not all) manufacturers have incorporated heavy elements in the fillers that strongly absorb X-Rays. The result is that a person of middle age is likely to have an assortment of restorative materials in the dentition, which will present differently radiographically.

In dental X-Rays, exposure conditions and film sensitivity are optimized to reveal structural features of bone, root, dentin, and enamel. Metal objects are at or near the limit of the dynamic range of the recording medium, and therefore appear as featureless radiopaque objects with no internal structure.

Resin alone is radiolucent, but with the addition of heavy elements can be made more radiopaque than enamel on a volume to volume basis. Indeed, the current trend is to ensure that the resin has a radiopacity equivalent to more than 3mm of aluminum, which exceeds enamel in an equivalent volume. Thus, today's resins are more radiopaque than enamel, and many times more so than dentin.

It is when a restoration is placed solely in enamel that detection becomes difficult. When the restoration extends into dentin, the clinician can easily recognize the intrusion of the more radiopaque material into the comparatively radiolucent dentin. Molar occlusal surface preparations, for example, may not be visible because that area of a radiograph may already show high radiopacity. In addition, the trend towards minimally invasive dentistry and preventative restorations may result in smaller and thinner restorations than were previously placed. The improved modern bonding techniques allow placement of small amounts of material without deep preparation. Even these small alterations form part of the uniqueness of the dentition, however, and they are therefore of importance for forensic identification.

In this study, the radiopacity of modern and historic resins was measured. Discs of resin 1cm in diameter and 1.7mm thick were prepared according to manufactures instructions. Slices of human dentin and enamel also 1.7mm thick were used as a control. For some of the historical resins it was found that the curing initiator was no longer active. In these cases it was possible to press a disc of the correct thickness bounded by a ring mold. A Nomad portable X-Ray unit was used as a source, and a Schick digital sensor was used to collect the radiographs. Exposure was optimized and a calibration curve was produced using increasing thicknesses of aluminum. The relative radiopacity of the resins was plotted using the gray level of the resin in the radiograph.

The results show that with one exception all the modern resins are significantly more radiopaque than the equivalent volume of enamel. The exception was Gradia (GC America), a product developed in Japan, in which country heavy elements in resins are not permitted. The flowable resins showed less radiopacity than their packable counterparts. The most radiopaque resins contained the highest atomic number elements in their filler particles. Particle size and filler loading also affected the radiopacity. These characteristics are described in a concurrent presentation.

The historical resins fell into two groups, one much less radiopaque than enamel, and one more radiopaque. The less radiopaque group contained silica as filler.

Examples of conservative restorations using modern resins were examined in order to ascertain their visibility in radiographs. Radiographs of unrestored, prepared, and restored teeth showed the potential

 ** Presenting Author*

difficulty of detection of these restorations, despite the increased radiopacity of modern resins.

In this presentation the radiopacity of modern and historical resins is measured and aspects of their detection in the dentition are explored. The continuing development of restorative materials demands that the effect of new formulations on resin characteristics is undersood. Similarly, the trend towards minimally invasive dentistry should alert the inspecting practitioner to expect more subtle evidence. As radiology is a key part of the forensic dental inspection, it is important to recognize potential limitations.

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 ** Presenting Author*