The Global Decline in the Use of Dental Amalgam Restorations

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Introduction

When posterior teeth, premolars and molars, develop significant carious lesions, they need to be treated through caries removal and placement of restorations. Currently, there are two widely used direct restorative materials, amalgam and resin composite, that are used by dentists globally for this purpose. However, over the last decade there has been a significant increase in the utilization of resin composite restorations on the expense of amalgam. A number of reasons led to this trend. While amalgam has been utilized by the profession as a long-lasting direct restorative material for over a century [1], however, recently there have been several concerns about its mercury content, color and restoration failures. While some amalgam restorations maintain their shiny silver appearance over the years (Figure 1), others undergo significant corrosion [2] with subsequent darkening of the restoration (Figure 2). Furthermore, the fact that there is a viable competitor, resin composite, that matches the natural color of the teeth, is a good reason for the shift. The majority of young adults of the current generation prefer to have their teeth restored with indistinguishable materials. Therefore, esthetics are a major driving force in this respect. Resin composite restorations can match the natural color of the teeth with a high level of accuracy (Figure 3). Their use by dentists in North America has been constantly on the rise [3,4].

Figure 1: Large amalgam restorations on mandibular molars. These were polished well and retained their surface lustre over time

Figure 2: This maxillary molar has a mesio-occluso-lingual amalgam restoration that suffered from corrosion resulting in unsightly appearance. Perhaps the alloy from which this restoration was made is to blame for the outcome

Figure 3: This maxillary second premolar has a disto-occlusal resin composite restoration that is indistinguishable due to optimal color matching

Amalgam and mercury

Dental amalgam restorations are made through mixing of an alloy powder primarily made of silver, copper and tin with liquid mercury at a ratio of 1:1 [5]. The resultant plastic mix is condensed into the prepared cavity before setting begins. Therefore, amalgam restorations have a 50% mercury content, however, in a reacted form. Mercury has been also used in several industries other than dentistry including paper mills, medical appliances as in thermometers, barometers, electrical equipment, dry batteries, semi-conductors and in paints. Recently, there has been global environmental concerns about the use of mercury in these industries. This led regulatory bodies in many parts of the world to require a number of industries to eliminate mercury, a heavy metal, from their products. This included the paints industry and manufacturers of dry batteries. In the dental profession, regulatory bodies in North America required all dental treatment facilities to have in place a special device, mercury separator, to collect elemental mercury from dental amalgam remnants as they pass through the wastewater lines. Furthermore, in 2008 in Norway, the use of amalgam restorations has been phased out [6,7]. A similar situation existed in Sweden and Denmark, while Germany has restricted the use of amalgam. In 2009, Health Canada has recommended that dentists should not place or remove amalgam restorations from the teeth of the pregnant women [8].

Amalgam failures

Amalgam restorations failures also played a role as a significant factor in the decline of their use [9]. Amalgam restorations may fail due to recurrent caries that occurs around the restoration margins (Figure 4). Another typical scenario for failure of Class 2 amalgam restorations is isthmus fracture (Figure 5). This can be caused by a variety of reasons that include: shallow cavity preparation, sharp internal lineangles and recurrent caries underneath. Furthermore, failure of amalgam restorations can be also manifested in the form of tooth fracture (Figure 6). This can be predisposed by preparing the amalgam cavities with sharp rather than rounded internal lineangles. Sharp internal lineangles tend to cause stress

concentration during function with subsequent fatigue and ultimately fracture of a cusp on the long term. Special burs with rounded corners that are pear-shaped can be useful in helping the dentist produce cavities with rounded internal lineangles. When severe, tooth fracture may render the tooth non-restorable (Figure 7). The risk of tooth fracture can be reduced when amalgam restorations are bonded to the tooth structure rather than being inserted as mere passive obturators.

Figure 4: A mesio-occlusal restoration on a mandibular first molar with evidence of recurrent caries at the gingival-buccal margin of the proximal area

Figure 5: Isthmus fracture of a mesio-occlusal amalgam restoration on a maxillary first molar.

Figure 6: This maxillary second premolar had an mesio-occluso-distal amalgam restoration that resulted in fracture of the lingual cusp

Figure 7: This maxillary second premolar had a mesio-occluso-distal amalgam restoration which caused the lingual cusp to fracture off. Because the fracture line extended subgingivally, the tooth was deemed as non-restorable and had to be extracted.

This shift in utilization of amalgam to resin composite is not surprising since change due to new technological advancements is inevitable in the dental profession. For example, over that last decade in North America, there has been a shift towards digital radiography and the archaic X-ray films with their developer and fixer solutions have quickly become obsolete. In the dental laboratory, there has been a shift towards the new technology of CAD-CAD designing and milling for fabrication of crowns, bridges and implant components. Simultaneously, the use of the aged lost-wax technique is gradually declining. In a recent statistical report from the largest dental laboratory in the USA, 90% of all crowns that dentists in the USA prescribed were made out of non-metallic materials using the CAD-CAM technology, mainly glass-ceramic and

zirconia. The remaining 10% were either cast gold or the traditional porcelain-fused -to-metal crowns.

Conclusion

In conclusion, it is not unexpected that the utilization of dental amalgam as a direct restorative material has dwindled and will continue to do so particularly when considering the fact that the dental profession has a mercury-free competitor, resin composite, that is capable of replacing dental amalgam with better tooth color matching abilities. In view of the global environmental concerns about mercury in dental amalgam, survival of amalgam as a direct restorative material is doomed.

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