ISSN: 2641-1962
DOI: 10.33552/OJDOH.2023.06.000643
Online Journal of Dentistry & Oral Health
Iris Publishers

Opinion



# Can We Stop Using Dental Amalgam?

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**Received Date:** January 03, 2023

**Published Date:** January 11, 2023

## Background

Dental caries is the second most widespread disease in humans, after the common cold. It is responsible for the destruction of the tooth and, left unchecked, has the potential to cause life-threatening systemic diseases. So, treating it is of paramount importance, and the thing that occupies most of the time of dentists worldwide.

For many years, the material of choice to repair the damage done by caries has been dental amalgam. Estimates are that some 75% of all restorations placed across the world are based on this material. Even in the U.S., where esthetic consideration count so much, amalgam is used for over 50% of all restorations.

Amalgam has a number of advantages which explain this widespread use. It is inexpensive, easy to use, strong and long lasting. Clinically its main disadvantage is its poor esthetics, as it is a silver colored metal. There are also concerns about its safety because mercury, a major component, is toxic. To deal with this, modern amalgams are supplied in sealed capsules, mixed in situ and placed by extrusion. After use, the capsule is disposed of in a carefully regulated way. Dental personnel are encouraged to work in well ventilated conditions and to avoid excessive exposure to mercury vapor.

## Safety Concerns

As well as issues with vapor at the time of placement, finished amalgam restorations can corrode and this releases mercury. Fortunately, studies have generally found that amounts of mercury liberated in this way are small, and not enough to cause obvious ill effects. However, exposure of this sort is obviously not desirable.

Some patients are considered at greater risk of adverse effects than others, and the U.S. Food and Drugs Administration (FDA) recommends limiting the use of dental amalgam in these patients. They include pregnant women, nursing mothers and children below the age of six years. However, the FDA does not recommend removing existing amalgam fillings because the act of removal may lead to a temporary increase in exposure to mercury. It may also damage the existing tooth structure.

Currently the FDA does not consider that there is enough evidence to support a complete ban on dental amalgam, despite these potential problems. Adverse effects do not seem to occur in the general population and the longevity of amalgam is better than that of the alternative materials.

## Minamata Convention

Worries about mercury and health, and the hazards of mercury pollution from extraction and industrial use, have led to the Minamata Convention. Named after the town in Japan that suffered a major episode of mercury poisoning in the late 1950s, this Convention was drawn up by the United Nations Environmental Program in 2013. It is a legally binding commitment to reduce and preferably eliminate mercury from all technical uses. Currently, over 140 countries and regions are signed up to the Convention, which has the major aim of completely eliminating mercury mining by the year 2032.

Arising from the Minamata Convention, many countries and blocs throughout the world have introduced legislation to limit or ban the import of mercury and the trade in mercury-containing products. These include the U.S., China and the E.U.

As a consequence, these countries have also committed themselves to phasing down the use of amalgam in dentistry. This is

associated with the promotion of a minimal intervention approach to tooth restoration and improvements in preventative measures aimed at reducing the prevalence of tooth decay. However, these measures alone are not enough to bring about the change to mercury-free dentistry.

## Banning Amalgam

Although the U.S. has decided against banning dental amalgam, other countries have gone ahead with a ban. The first to do so was Norway, in 2008. A year later, Sweden followed them. Since then, Denmark has put significant restrictions in place, and plans are well advanced for similar measures in Finland, the Czech Republic, Ireland and Slovakia. Other countries are holding back only because of the possible economic impact on the healthcare systems.

## Alternative Materials

Given all these concerns, what are the alternatives? Effectively, there are two groups of materials, the resin composites and the glass-ionomer cements, though there have been attempts to create hybrids between these two main groups. Both types are less polluting to produce than dental amalgam as well as safer to dispose of. As well as that, there is much less concern about adverse health effects when these materials are used in patients.

### Resin composites

These materials are made from blends of large monomer molecules filled with an inert reinforcing filler, such as quartz powder. Setting is generally light-activated and involves polymerisation. These substances need to be used with speciality bonding agents but their high esthetics make the effort worthwhile. As a result of their excellent appearance they are popular with both patients and dentists.

However, they have a number of drawbacks. Because the tooth needs careful preparation, they are difficult to place. A dry field is necessary, which means that a rubber dam has to be used, and application of the liquid bonding agent has to be done precisely to ensure adequate adhesion and a sound seal to prevent the entry of micro-organisms. These requirements, coupled with the reliance on the dental drill and bespoke cure lamps means that sophisticated operating conditions are needed. Hence resin composites cannot be easily used in poor communities such as those in the Third World.

Resin composites are not as durable as dental amalgam fillings. This puts extra demand on the dentists' time, as they must devote some effort to repairing and replacing existing composite restorations. As a result, resin composites are best suited for wealthier parts of the world, where there are relatively high numbers of trained dentists, such as the U.S. and Europe. They are much less suited to use in poor countries, where numbers of dentists are much lower.

### Glass-ionomer cements

These are two-component materials usually presented as an aqueous solution of acidic polymer, such as polyacrylic acid, and a basic glass powder. The two parts are mixed together at the chairside to make a viscous paste that is placed and allowed to harden, which it does by neutralisation. The set cement is reasonably esthetic, though not as good as the resin composite, and it forms a strong adhesive bond to the tooth without the need for bonding agents. These cements have the added advantage that they release fluoride, which may help prevent secondary caries.

Glass-ionomers can be used without extensive tooth preparation, and this makes them easier to use in poorer communities where dentists have less access to sophisticated clinical equipment. However, they are more brittle than resin composites and their durability is also lower than that of amalgams.

## The Current Situation

As we have seen, the need to ban the use of mercury in technical applications means that there is pressure to stop using amalgam in dentistry. The problem is that the alternative materials are not as durable and, in the case of resin composites, more demanding to place. Modern materials, especially resin composites, give excellent results in affluent communities, where standards of oral care are good, and dental offices are well equipped. Also, where there are sufficient numbers of highly trained dentists able to place and maintain the restorations. These conditions do not apply in most of the world; they do not even apply in the poorer parts of rich countries such as the United States. This is the reason that dental amalgam is still so widely used.

Although not popular in those areas with the facilities to get the best from resin composites, glass-ionomer cements seem to show more promise for use in poorer communities. They are already employed in the ART technique in Third World countries, mainly for children but also increasingly for adults. Cavity preparation does not use dental drills and the cement sets without the need for dental cure lamps. Hence the technique makes dental treatment cheap to provide and suitable in areas where electricity supply is unreliable or absent.

## The Future

The Minamata Convention makes it inevitable that the use of dental amalgam will decline. However, at the moment the world really isn't ready for this radical step.

To become so, we need a concerted effort to develop improved materials, probably of the glass-ionomer type. Ideally, they should be able to be placed under demanding field conditions, preferably by trained dental auxiliaries rather than by highly educated dentists. Once placed, they should perform well in service with little or no change in their appearance. When they do fail, they should be capable of being repaired or replaced with minimal effort. This would address the clinical needs of the majority of the world's population better than the current efforts of dental materials researchers. Rather than the current emphasis on complicated materials of ever improving esthetics, we need materials that are simple, robust and easy to place.

Only then will we be able to achieve our ideal and get rid of amalgam from our dental clinics.

## Acknowledgement

None.

## Conflict of Interest

No conflict of interest.