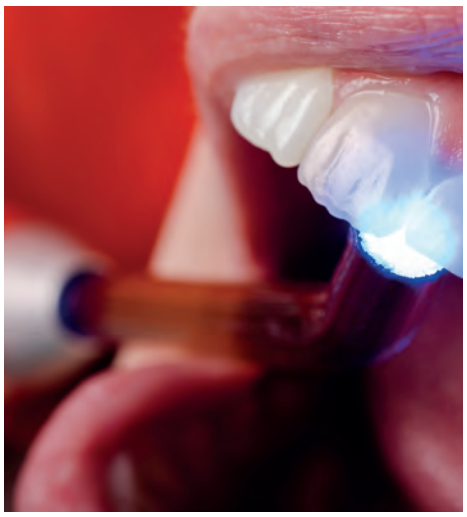
Module 5: Restorative Dentistry

The fifth module in the BDIA Certificate covers restorative dentistry.



Restorative dentistry is the study, examination and treatment of diseases in the oral cavity and covers a wide range of dental procedures that are commonly experienced by patients. The procedures form the backbone of dentistry, covering operative dentistry, endodontics, periodontics and prosthodontics (which includes dental implants). The main aim is to restore function, comfort and, sometimes aesthetics, though this is not always possible.

These disciplines are described as:

- Operative dentistry – restoring parts of teeth that have become defective; 'fillings' in common parlance.
- Endodontics – dentistry associated with 'root canal'.
- Periodontics – dentistry associated with the gum and periodontal ligament.
- Prosthodontics – 'false teeth', including those supported by dental implants (covered in the next module).

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Cavities

When teeth develop caries, the caries must be removed along with any infected dentine. Care must be taken not to expose the tooth pulp in doing this (as this would result in further infection and the need for endodontics). Caries would generally be removed with hand instruments and diamond burs in high-speed handpieces, giving the characteristic (and sometimes dreaded) 'whirr' of the dentist's drill. It is desirable to minimise the amount of healthy tooth removed during the preparation of a cavity, for the long-term health and strength of the tooth.

The cavities formed once caries are removed are classified according to the over 100-year-old 'Black's Classification':

- Class 1 – a single cavity involving one tooth surface (buccal, occlusal or mesial, abbreviated to B, O or M).
- Class 2 – affecting two or more surfaces of premolars and molars (BO/MO or MOD).
- Class 3 – affecting two surfaces (buccal and mesial) of anterior teeth (which have no occlusal surface).
- Class 4 – affecting two surfaces of anterior teeth and extending to the incisal edge.
- Class 5 – cavities at the cervical margin.

In creating a cavity, care must be taken to keep the site dry. The use of latex sheets (rubber dam) can be employed (non-latex versions are available). Here, a small hole is made through which the tooth being worked on shows through; this keeps the site dry and also prevents foreign bodies being inhaled. However, rubber dam is not always employed and the site can be kept dry with cotton rolls and suction.

Especially large cavities may need to be lined with a special dental cement before the filling material is applied; this gives additional protection to the pulp.

Filling materials – Temporary cements

A cavity can be quickly filled with a temporary cement (generally based on zinc oxide and eugenol). They are generally employed to manage sensitivity before a permanent solution can be used.

Filling materials – Amalgam

Amalgam is a common, inexpensive, strong and durable filling material that has been used for well over a century. However, being a mixture of silver, tin and mercury, an amalgam filling is not an aesthetic choice with its dark grey metallic appearance. The presence of mercury can also be controversial as it has a poisonous vapour. Both of these factors have contributed to the increased adoption of composite, tooth-coloured materials.

Amalgam is banned in some European countries, due to the toxicity of mercury vapour. Prolonged exposure will build up in the body and can have neurological implications. Therefore, care is required during placement and preparation.

The preparation of an amalgam filling requires powder and liquid to be mixed in the correct proportions, which is done in an amalgamator or by using pre-dosed capsules mixed in a machine. An amalgam cavity will also need lining to insulate the tooth from sudden temperature changes which will be transmitted through the metal. Other items that may be used are amalgam pluggers (to ensure the amalgam fills the entire cavity), pins to create additional strength and matrix bands to contain amalgam in a cavity that has an open side. Amalgam restorations will set with time.

Filling materials – Composite

Composite filling materials are

composed of filler particles, resins and a catalyst. The catalyst is used to set the material and, in modern materials, this can be activated by light (to give more control over setting). Most composites today are light controlled (light curing).

Most resins are based on methacrylate, commonly 'Bis GMA' and 'urethane dimethacrylate'. Composite materials often come in a wide range of shades for an aesthetic finish, regardless of the patient's tooth colour. When cured, composite materials shrink, which can cause pain, so large restorations may be filled in smaller, incremental layers to counteract this.

The filler particles used will define which composite class they fall into:

- Microfilled (aesthetic, but not strong)
- Macrofilled (strong, but not aesthetic)
- Universal (a hybrid of the two)

Composite materials are not self-retaining, so they need to be bonded using dental adhesive systems. To increase retention, bonds require etching and priming. You can etch (to roughen the surface) with 37 per cent phosphoric acid, or with microetchers (with a jet of aluminium oxide). Some bonds now combine the priming and bonding steps, care must be taken that the bond and composite are compatible, so the two can fuse together.

Composites can also have their critics as the chemicals they contain can also be toxic.

Filling materials – Glass ionomer cements

The last type of filling material covered in this module requires no separate bond and, generally, no lining, but has limitations in its application, as it is not strong enough to withstand chewing. Some are also able to release fluoride into the tooth to help prevent secondary caries.

Due to simple application, but limited strength, they can be used in children's deciduous teeth and cervical (class 5) cavities.

There are a range of glass ionomers which can be light or self-cured. The range includes compomers (modified composites that release fluoride) and fissure sealants, which can be used as a layer to fill deep fissures on children's permanent molars as they erupt to prevent caries. These need to be used correctly, as incorrect use could seal in debris and cause, rather than prevent, caries.

Footnote

Cavities can also be filled with ceramics (as an inlay or an onlay) but this type of restoration is covered in Module 6, which addresses crowns.

Endodontics, cores and posts

At the end of the module, the BDIA refers to endodontics in brief, where infected pulp is removed and replaced with inert material (gutta percha). The remaining tooth may then be rebuilt using cores and posts – similar to pins, these can reinforce a weak tooth and act as a base for a new crown to be added onto.

Restorative dentistry really covers the bulk of what the average person in the street may think a dentist does but, in reality, it is just one facet (albeit an important one) of dentistry.

The amalgam debate

Say no to amalgam. **Alpana Warke Vijayaraghavan** presents the argument for composites.

Dental amalgam, a combination of metals with 50 per cent mercury, is a common material to fill dental cavities; it was invented in 1819 and first used in England and France in 1826. As early as the 1840s, the American Society of Dental Surgeons denounced the use of amalgam as a poor filling material due to concerns about mercury poisoning.

The voice of dissent and safety concerns started immediately with pledges to ban its use, however, due to a lack of suitable alternatives back then, dental amalgam survived. With a plethora of tooth-coloured, aesthetic, long-lasting, modern and biocompatible materials now available, there is absolutely no rationale or compulsion to use dental amalgam today. Many dentists still continue using amalgam, possibly due to misinformation by parties with vested interests, and manufacturers continue producing it. It is time to put a stop to it as we, the most evolved species, should take responsibility to stop using dental amalgam and to stop harming the planet.

Toxic or very toxic to health?

There is no debate on whether mercury is toxic or not... it simply is! Mercury is a powerful neurotoxin and can cause neurological/mental disorders and autoimmune and chronic diseases. Mercury vapours from dental amalgam are emitted when chewing and brushing teeth, causing daily exposure, which, when inhaled, are absorbed by the lungs. However, the greatest degree of exposure occurs during restoration and removal. This poses significant health risks as mercury bioaccumulates in kidneys, brain and organs, endangering health. In February 1992, medical scientists presented studies showing adverse health effects of mercury exposure from amalgam fillings.

Erethism mercurialis, or 'mad hatter' disease, is a neurological disorder affecting the central nervous system resulting from mercury poisoning. Historically, the old England felt-hatmakers used mercury to stabilise wool in the felting process; they developed neurological symptoms due to mercury vapours exposure, giving rise to the expression 'mad as a hatter'.

The developing neurological systems in foetuses, infants and children are more sensitive to the neurotoxic effects of mercury vapour – another reason to ban dental amalgam.

Environmental hazard

The World Health Organization (WHO), European Commission and various bodies worldwide agree that mercury is an environmental poison and a significant contributor to environmental emissions from human activities. A significant proportion of mercury in sewage comes from dental practices and mercury emissions are deposited into soil, surface water and vegetation. Half of the mercury released from current and historical dental amalgam can contaminate fish or be stored in hazardous landfills. The EPA declared amalgam removed from teeth a toxic waste and even the ADA warns that amalgam is hazardous to dental staff. Here in the UK, cremation of bodies containing amalgam restorations leads to high atmospheric mercury emissions – a massive concern.

But all this is easily preventable; why use this material at all when so many viable long-lasting restorative alternatives are available? I would like to see dental amalgam banned completely!

Longevity at the expense of a fractured tooth?

One point touted in favour of amalgam is the longevity of fillings which can last 10, 15 or even more years. However, research has shown that dental amalgam fillings expand and contract slightly over time, causing the surrounding tooth structure to become unstable, eventually causing it to crack. So, while there is no dispute that dental amalgam is long-lasting, this is at the cost of losing the tooth itself.

Against the grain of MI dentistry

Dentists' 'drill and fill' approach for dental amalgam goes against the concept of minimally invasive dentistry. The dentist has to drill out a lot more viable/healthy tooth structure for a key-shaped preparation to mechanically hold amalgam in the cavity.

Techniques for alternative tooth-coloured glass ionomers and composites on the other hand are minimally invasive, and these restoratives are biocompatible, provide great aesthetics and cater even to demanding patients, which is why dentists use them a lot more.

Economical and quick?

Dentists inexperienced with mercury-free alternatives claim that amalgam is quick to place, but nations like Denmark have made the transition, so we can discount this claim.

Tide of opinion

Why does this 190-year-old controversy continue? Many countries, including Norway, Sweden, Denmark, Russia, Japan and Germany, have banned dental amalgam. The UN Treaty requires all countries to phase down dental amalgam. French dentists moving away from mercury fillings are calling for a complete ban.

Consumers for Dental Choice worldwide battle for mercury-free dentistry. An EC public vote resulted in 88 per cent voting for an amalgam phase-out as opposed to a measly 12 per cent to keep amalgam. Every major EU institution supported amalgam in 2010, but by 2016, no major EU institution did. And think about it... would you like a tooth-coloured filling in your mouth?

Alpana Warke Vijayaraghavan is a marketing manager at The Dental Directory.

Revolution not evolution. **Julian English** puts forward the case for the clinical qualities of amalgam.

Having dental treatment is a long, winding downward road. The majority of dental treatment just leads to more treatment later on. Each time it is restored, an increasing amount of natural tooth structure is lost. A small filling leads to a larger filling, that leads to a crown, then endodontics and a bridge and possibly tooth extraction. The more dentistry one has, the more invasive the requirement. So, wouldn't it be great if there was a filling material that could last 10 or 20 or even 30 years?

An amazing product

Back in the day there existed an amazing product used ubiquitously for fillings large and small that could last decades. Indeed, there are countless published research comparisons of this wonder material's longevity in situ. It was called amalgam. Sadly, it is deeply unpopular in the 21st century. But its efficacy for long term results is without question.

There is an element of irony about the fact that as amalgam dies, minimally invasive dentistry has risen in prominence and is now seen as the ethical way forward. Composite, amalgam's replacement, is more aesthetic, but does not last as long. This is fact; medical studies report a greater longevity for amalgam fillings than for composite fillings. And there is a lot of evidence (probably all commissioned by the Mercury Mining Corporation!).

Fillings are the most numerous dental treatment in the UK. In an ideal world, amalgam would be the material of choice for the clinician wanting to achieve the optimum minimally invasive treatment. Why? Because the expected survival time of an amalgam filling (according to the research) is from 10 to 30 years. The expected survival time of a composite filling is five to nine years.

As I explained earlier, the more fillings one has on the same tooth, the more tooth is lost. Decay is irreversible.

Julian English is the editor of *Dentistry*.

We all know

We all know that when decay in a tooth reaches the pulp, then endodontics may be required, rendering the tooth inert but effectively dead.

We all know that when decay spreads too far in a tooth it may need a crown, which involves a deep preparation, laboratory work and several visits for invasive treatment. Endodontics may be involved. The condition is irreversible.

We all know polymerisation shrinkage of composite fillings opens a small door for the introduction of cariogenic material into the sides and underneath of a composite filling. Modern advanced composites go a long way to combat this and should be applauded for it.

We all know caries is one of the most prevalent diseases worldwide.

We all know amalgams have been used for more than 150 years for the restoration of carious lesions.

We have forgotten

We have forgotten the advantages of amalgam are its high resistance to wear.

We have forgotten amalgam has excellent marginal adaptation and its easy processability in combination with a low error-proneness.

We have not forgotten that patients reject this wonder material on the grounds of aesthetics and safety concerns over mercury.

We have forgotten how much cheaper amalgam is to purchase and apply.

We have forgotten how easy it is as a material to work with.

Conclusion

I'm not here to suggest a revolutionary return to amalgam as the material of choice for fillings. But evolution of filling materials has gone in a direction forcing a trade-off for the patient. The public is now willing to trade the hard-wearing qualities of amalgam for this lower-wearing aesthetic alternative. The public accepts it is a shorter-term solution. The public is also willing to pay more, and more frequently, for composite fillings.

I'm no high-roller and I can afford composite fillings but, for my offspring with caries, I would have to think long and hard about the inevitable long term consequences before choosing the more aesthetic option.

References available on request.