

Consequences of Amalgam Restorations on Soft Tissues of the Oral Cavity

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Abstract: ***Aim:** To do a review on the effect of amalgam restorations on the oral cavity. **Objective and background:** Amalgam is the mixture of alloy particles along with mercury. It has been one of the best restorative materials used in dentistry for the past 150 years. It is also sometimes called Silver Amalgam. The metals present in it would include silver, mercury, tin and copper. Small amounts of zinc, indium or palladium also may be used. Due to the high metal content, especially mercury, concerns have been raised. In rare cases, patients develop allergic conditions due to their amalgam fillings, lesions can be developed due to the mercury content. The leakage of mercury from the restorations can cause conditions such as pigmentation of the oral tissues (amalgam tattoo), chronic gingivitis, pre cancerous lesions, toxicity, bleeding gums, sinusitis etc. This review is done in order to understand the adverse effects of amalgam restorations and to know the various ways in which it can be prevented. **Reason:** This review is done in order to understand the wholesome effect of amalgam restorations on the oral cavity. It is important for dentists to be aware of all these conditions in order to safe guard the health of patients. The patents will also be more aware of signs and symptoms and can consult the dentist to prevent worse conditions.*

Keywords: Amalgam, soft tissues, lesions, hypersensitivity

1. Introduction

Amalgam is the mixture of alloy particles along with mercury. It is one of the most versatile materials used in dentistry. It mainly has restorative purposes and it contributes to almost 75% of all restorative materials used by dentists. It has been used as a restorative material for the past 165 years and a more economical alternative for it is still yet to be found. It has long term performance, good load bearing properties and is self-sealing.

Amalgam has been suggested as a filling material since 1819 by an English chemist, Bell. It is widely used because of its strong nature and as a result can provide a durable chewing surface. They can be inserted more quickly than other filling materials and can be used easily when treating children. They are less expensive and last longer than other filling materials as well.

In the current few years, it has been noted that the usage of amalgam for restorative purposes has gone down drastically. This is mainly due to the concern raised by both doctors and patients about the adverse effects that follow amalgam restorations. [1] The high mercury content in the material has raised concern over conditions such as mercury toxicity, gingivitis, oral gum tissue inflammation, bleeding gums, bone loss, mouth sores, oral lesions, pain and discomfort, burning mouth, metallic taste, chronic sore throat, chronic inflammatory response etc.

Mercury that's present in amalgam fillings, because of its high volatility and galvanic action, has been found to continuously vaporize and release into the body. People with amalgam fillings are seen to have high contents of mercury present in their body.[1],[2] This is mainly due to the leaching mercury during delayed expansion of the filling. Removal of amalgam restorations might significantly affect mercury levels in plasma and urine.[2]

Along with the effects on the oral cavity, they also effects specific organs and systems in the body.[2]Conditions such as kidney dysfunction, neurotoxicity, compromised immune system, amalgam illness, etc. Incidences have been reported regarding the harmful effects of mercury from amalgam in pregnant women and children. Tremors, impaired vision and hearing, paralysis, insomnia, emotional instability, developmental deficits during fetal development, and attention deficit and developmental delays during childhood are all the adverse effects that are noticed. [1]It has been reported that children are more at risk compared to adults. Concern has also been brought up regarding the safety of dentists and dental personals in their work place. [1, 3-5]It has been reported that amalgam intake has been estimated to be ranging from 1 to 27 ug[mcg]/day[1, 6]

Solutions to mercury risks caused by dental amalgam are found to be amalgam separators, alternate amalgam filling materials, safe removal of existing restoration etc.

2. Composition

Dental amalgam as said before constitutes of many metals. Silver is used to increase the strength of the alloy and for expansion. Tin decrease strength and expansion and lengthens the setting time. Copper increases strength, reduces tarnish and corrosion, and reduces creep and, therefore, marginal deterioration. Zinc is added to prevent oxidation of the other metals and it also helps keep the alloy from turning dark.

Dental amalgams are of two types and they are low copper and high copper amalgam. Low copper amalgam was used more in the past and it has been almost fully replaced by high copper amalgam. High copper amalgam has high strength, less corrosion and tarnish, less creep and is more long term. It also has less chances of marginal failure.[7]

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Mechanical mixing of amalgam is mostly followed for the preparation of amalgam. Most dental amalgams are a mixture of silver and tin in 3 to 1 ratio, and they will have less proportions of copper and zinc. Conventional dental amalgam contains 67% silver, 25% tin 6% copper, 2% zinc and 3% mercury.[8]

Mercury is one of the toxic constituents present in amalgam. Its vapors when in the body, will pass rapidly through cell membranes, crosses the blood brain barrier and into the central nervous system. It causes immunological and psychological problems[9]

The effects of amalgam restorations on the oral soft tissues are discussed in this article.

3. Brief History

When amalgam was first introduced, many dentists were concerned about inserting a highly toxic metal into a patient's mouth. This controversy was later termed as "First amalgam war". Their concerns were quietened later when mercury was said to be safe to use as it stabilizes in the hardened amalgam and didn't come out. Since it was not that expensive a material, it was more frequently used as well. The controversy surfaced again in 1926 when a German physician showed that mercury escaped from the filling in the form of dangerous vapor and this was called "Second amalgam war". The third amalgam war initiated when they found out that mercury vapor escapes from the filling and into the patient's mouth, making its use unethical.

Effect of mercury from amalgam on oral health

Vapours of mercury are released during insertion, condensation and the carving of amalgam. It can also be released during further processing and removal. The amount of mercury in the restoration can be reduced by about 6-10% by good condensation. Components of amalgam may, in rare instances, cause local side effects or allergic reactions referred to as oral lichenoid lesions (OLLs).[10-12]. There are three main reactions of amalgam on the oral tissues and they include: type IV sensitivity, toxic reactions, and a much rarer phenomenon, acute or generalized sensitivity. [10]

Hypersensitivity

Amalgam is capable of producing delayed hypersensitivity reactions in some individuals and they are mostly related to dermatological or oral symptoms.[1] The most common reaction to amalgam is the development of oral lichenoid reactions/lesions (OLRs/OLLs) involving mucosae in direct contact with amalgam restorations. OLLs are mostly the local allergic reactions that are caused by amalgam and its contents. It is seen as hypersensitivity reactions in low level mercury exposure.[10] Symptoms of an amalgam allergy include skin rashes, swollen lips, localized eczema-like lesions in the oral cavity. In some cases, they disappear within a few days and in other instances, the amalgam restoration will have to be removed and replaced by an alternative restorative material.

Mercury allergy

Most patients are not tested for mercury allergy before getting exposed to the filling material. According to surveys

done, millions of people are mostly unaware of the fact that they are allergic to the metal present in the filling and as a result have to suffer through systemic conditions. [13] It is important for the dentists to be well aware of the possible side effects of amalgam so as to ensure no complications, better prevention and to ensure correct treatment to patients in their clinics. It is also observed that the removal of amalgam fillings can lead to oral keratosis or pre-cancer.

Toxic reactions

Toxic reactions can develop if an irritant substance is in direct contact with the mucosa over several years. They resemble OLLs that are caused due to hypersensitivity reactions. Toxic reactions are more common in amalgams with higher zinc content.[10] OLL are mostly inflammatory pre-cancerous conditions. [14]

Mercury toxicity

The amount of mercury present in the body that reaches the target organ will determine the extent of the poisoning. To determine if a person is poisoned, blood levels are measured. In severe cases, urine levels are also measured and observed to be excess.[15]

Toxic or allergic reactions to amalgam can result in autoimmune conditions such as OLL in the oral mucosa or gums, eczema, dermatitis and they also play a role in many of the periodontal diseases. [16]

Amalgam tattoos

Amalgam tattoos are lesions that are caused by traumatic implantation of dental amalgam into soft tissue. It is the most common localized pigmented lesion in the mouth. It is an area of discoloration in the mouth caused by the migration of particles of dental amalgam which become embedded under the oral membranes, causing a patch of gray, black, or blue to appear.[1] Amalgam debris are able to enable immunological adaptive reactions where tissue reaction to amalgam tattoo depends on the amalgam particles size and composition. The residual elements of amalgam tattoo develop noxious effects where the mercury passes from the tissue fluid into the blood stream and accumulates in the kidneys. Amalgam particles can get embedded into the soft tissues of the mouth accidentally, most commonly in the gingiva, during amalgam removal. This is also another way in which amalgam tattoos are formed. [17]

Amalgam Blue

A tooth that has been filled with the help of amalgam filling will weaken over time and result in the grey-blue appearance of the enamel on the tooth. This condition is referred to as amalgam blue. They mostly mimic secondary caries. It mostly occurs due to the leakage of amalgam from the restoration. They penetrate and corrode the dentinal tubules.

Mercury from the amalgam can also get leaked out and can be found in the lysosomes of macrophages and fibroblasts of submucous connective tissue of contact tissue. They can also be found in oral lichen planus lesion. [18] It can also cause a lot of histopathological changes to the oral tissues.

Amalgam restorations are also found to be irritating to the pulp. This is mainly due to the physical insertion of the material and the improper condensation. The amalgam that contains more copper content usually causes pulpal response in the form of sensitivity. [18]

Amalgam can sometimes be found implanted in the jaw bone as a result of old fashioned retrograde fillings and this can lead to severe conditions.

Gingivitis and other periodontal diseases

The presence of restorative material on tooth surfaces are one of the major cause for periodontal diseases.[19] This observation was made by the increased accumulation of plaque on the restorations that were adjacent to the gingiva. Plaque is said to adhere better to restorations than to the enamel. This is mainly due the characteristics of the materials such as surfaces roughness. It can mainly be prevented by maintaining proper oral hygiene. Plaque induced gingivitis is mainly seen at the gingival margin. The formation of plaque on the surface of the enamel or restorative material will effect the adjacent soft tissues and result in an inflammatory response.

Inflammatory reactions

Many studies have shown that mercury that gets leaked from amalgam and accumulate in the soft tissues, lead to chronic inflammations, including proliferation of inflammatory cytokines and migration to other parts of the body.[16]

4. Other Effects

Through numerous studies, it was observed that in some patients, amalgam caused many adverse reactions in the oral cavity such as burning sensations, dry mouth (xerostomia), bleeding gums, pain and discomfort. These are mostly symptoms that are seen around the filling regions. In most cases, these symptoms are in relation to amalgam tattoos or amalgam blues. They can also be the result of allergic reactions that take place due to the amalgam. [20]

5. Preventive Methods

All these effects of amalgam can be prevented by following cautionary measures. The operator must be properly ventilated. The excess mercury should be collected and restored in well-sealed containers. Proper disposal of amalgam waste material should be done to prevent environmental pollution. Proper mixing of the amalgam in the precise ratio must be followed. Proper condensation of the amalgam must be done. If spilt, it must be cleaned properly. While grinding amalgam, water spray and suction should be used. Other amalgam substitutes could be used as restorative materials such as GIC or composites. Amalgam separators can be used to reduce the amount of mercury that is discharged from dental offices into waste water. Alternates to amalgam include composite resin, glass ionomer, porcelain, gold and other materials. The most common choice is composite as it is esthetically more convenient due to its white color and cost being moderate.

Removal of any dental material requires a lot of precautions. It is mandatory to be cautious while removing dental

amalgam fillings. Unsafe removal of amalgam releases mercury vapor and other such particles that can be harmful to the patient, dentist, staff and the environment. [21]

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