

## Side Effects and Complications of Dental Materials on Oral Cavity

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**Abstract:** Development of dental materials has had a great impact on the modern dentistry. The materials ranging from polymers to metals have different applications in dentistry. Besides their important role in healing or improving the function of oral tissues, the materials may show side effects which may, in some cases, lead to severe lesions. In this review the side effects have been summarized considering a new classification for dental materials according to the duration of their applications as temporary or permanent materials. The side effects of the materials are then discussed based on clinical and cellular views.

**Key words:** Dental materials, side effects, oral tissues, cytotoxicity, lesions

### INTRODUCTION

Dental materials have been categorized in different ways. In this review a new criterion has been considered to categorize them into different classes. Dental materials are divided upon the time period of their application as *temporary* and *permanent* materials. The temporary materials are applied for a short period of time usually to heal a tissue or improve its function. Although the materials have often temporary effects, the effects may recur every time which they are applied. The permanent materials are often used to replace a tissue or recover its function and should keep the function as long as possible (Table 1).

Table 1: Classification of dental materials

A- Permanent materials	- Restorative materials: Amalgam, composites, etc. - Reconstructive materials: Denture base, Implants, etc.
B- Temporary materials	- Therapeutic materials: -Medicine, Mouth washes, tooth pastes, chewing gum, food additives - Devices: Brackets, orthodontic plaque, wires, ..

The side effects of the materials are then discussed according to this classification considering clinical and cellular views.

Numerous studies have been performed to understand and improve physical and mechanical

properties of dental materials<sup>[1-10]</sup>. Fewer attempts have been made to assess the biocompatibility of the materials. Although physical and mechanical properties are very important in selecting a material for dental application, the biological characteristics of the material cannot be isolated from its physical and mechanical properties and biological considerations should also be associated with the selection and use of materials designed for the oral cavity.

When a biomaterial is placed in contact with the tissues and fluids of the human body, there are invariably some forms of interaction between the material and the biological environment. This interaction forms the subject of biocompatibility<sup>[11]</sup>. A material may be said to be *biocompatible* when it has the quality of being non-destructive in the biological environment. It is important to appreciate that this interaction works both ways. That is, the material may be affected in some way by the biological environment, and equally, the biological environment may be affected by the material<sup>[12]</sup>. The biological reactions can take place either at a local level or far removed from the site of contact (i.e. systemically). The latter is a very important consideration. Because it may not always be readily apparent that clinical symptoms such as dermatological, rheumatic or neural reactions could be associated with a biomaterial. Both patients and the dental personnel are exposed to these interactions and the potential risks, with the patient being the recipient of the restorative materials and the dental personnel handling many of the materials on a daily basis<sup>[12]</sup>.

Material that is to be used in the oral cavity should be harmless to the pulp and the soft tissues. Also, it

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should contain no toxic diffusible substance that can be absorbed into the circulatory system to cause a systemic toxic response. The material should be free of potential sensitizing agent that could lead to an allergic response. Finally, the material should have no carcinogenic potential. In the sections that follow, where indicated, reference will be made to reported allergic, sensitizing, or toxic effects of components found in certain restorative materials, such as mercury in dental amalgam or nickel in casting alloys<sup>[13]</sup>.

This study evaluates almost all side effects and orders them based on *i*-clinical view, *ii*-region, and *iii*-type of materials.

#### **Side effects on oral mucosa (based on clinical view): Lichenoid reaction**

Lichenoid reactions and lichen planus exhibit similar histopathologic features. Lichenoid reactions are differentiated from lichen planus on the basis of their association with the administration of a drug, contact with a metal, the use of a food flavoring, or systemic disease and their resolution when the drug or other factor is eliminated or when the disease is treated<sup>[14,15]</sup>. Clinically, lichenoid lesions may exhibit the classic appearance of lichen planus, but atypical presentations are seen. Some of the dermatologic lesions included in this category show little clinical lichenification<sup>[14]</sup>.

**Amalgam tattoo:** By far, the most common source of solitary or focal pigmentation in the oral mucosa is the amalgam tattoo. The lesions are macular and bluish gray or even black and are usually seen in the buccal mucosa, gingivae, or palate. Importantly, they are found in the vicinity of teeth with large amalgam restorations or crowned teeth that probably had amalgams removed when the teeth were being prepared for the fabrication of the crown. Such lesions are the consequence of an iatrogenic mishap whereby the dentist's bur, loaded with small amalgam particles that accumulate during the removal of amalgam, accidentally veers into the adjacent mucosa and traumatically introduces the metal flecks<sup>[14, 15]</sup>.

**Contact stomatitis:** Contact allergy results from a delayed hypersensitivity reaction that occurs when antigens of low molecular weight penetrate the skin or mucosa of susceptible individuals. These antigens combine with epithelial-derived proteins to form haptens that bind to Langerhan's cells migrate to the regional lymph nodes and present the antigen to T lymphocytes, which become sensitized and undergo clonal expansion. After re-exposure to the antigen, sensitized individual develop an inflammatory reaction confined to the site of contact. Since the reaction

resulting from contact allergy appears as nonspecific inflammation, contact dermatitis is unknown, but it is believed to be significantly less common than contact dermatitis for the following reasons:

- a. Saliva quickly dilutes potential antigens and physically washes them away and digests them before they can penetrate the oral mucosa.
- b. Since the oral mucosa is more vascular than the skin, potential antigens that do penetrate the mucosa are rapidly removed before an allergic reaction can be established.
- c. The oral mucosa has less keratin than does the skin, decreasing the possibility that haptens will be formed<sup>[14]</sup>.

Contact stomatitis may result from contact with dental materials, oral hygiene products, or foods. Common causes of contact oral reactions are cinnamon or peppermint which are frequently used as flavoring agents in food, candy, and chewing gum, as well as oral hygiene products such as toothpaste, mouthwash and dental floss<sup>[14, 15]</sup>.

Dental materials that have been reported to cause cases of contact allergic stomatitis include mercury in amalgam, gold in crowns, free monomer in acrylic, and nickel on orthodontic wire. Pyrophosphates and zinc citrate, which are components of tartar control toothpaste, cause superficial peeling of the mucosa in some users, but this reaction is believed to be caused by physical irritation rather than an allergic reaction<sup>[14, 15]</sup>.

**Geographic lesions:** Geographic tongue (erythema migrans, benign migratory glossitis, erythema areata migrans, stomatitis areata migrans) is a common benign condition affecting primarily the dorsal surface of the tongue. Its incidence varies from slightly over 2% in the US population to 11 to 16% in other populations. The conditions are usually asymptomatic, but in one study of patients who experienced burning in the mouth, the burning was associated with geographic tongue in 24% of the patients. Metal material as amalgam, gold, orthodontic wires can lead to geographic tongue<sup>[14, 15]</sup>.

**Recurrent aphthous stomatitis(RAS):** RAS is a disorder characterized by recurring ulcers confined to the oral mucosa in patients with no other signs of disease. The current concept is that RAS is a clinical syndrome with several possible causes. The major factors identified include heredity, hematologic deficiencies, and immunologic abnormalities. The best documented factor is heredity<sup>[14]</sup>.

A detergent present in toothpaste, sodium lauryl sulfate (SLS), was suspected as an etiologic factor in RAS development, but a recent double-blind crossover

study showed that use of an SLS-free toothpaste had no significant effect on ulcer development<sup>[14, 15]</sup>.

**Side effects on teeth (based on clinical and cellular view): Staining**

Dental restorative materials, especially amalgam, can result in black-gray discolorations of teeth. This most frequently arises in younger patients who have more open dentinal tubules. Large class II proximal restorations of posterior teeth can produce discoloration of the overlying facial surface. In addition, deep lingual metallic restorations on anterior incisors can significantly stain underlying dentin and produce visible grayish discoloration on the labial surface. To help reduce discoloration, the clinician should not restore endodontically treated anterior teeth with amalgam<sup>[16, 17]</sup>.

**Tooth's pulp reactions:** Few, if any, dental materials are totally inert from a physiological standpoint. They contain a variety of potentially toxic or irritating ingredients. In addition, the chemical reactions that occur during the setting or hardening of the material may produce an undesirable effect upon the pulp.

Thus it is apparent that the dental pulp may be subjected to various types of injury before, during, and after restoration of the carious tooth<sup>[12]</sup>.

To summarize, heat and desiccation during cavity preparation can cause injury to the pulp. Damage may occur during the insertion of the restorative material, as by the pressure of condensing direct gold or amalgam and the hydraulic pressure produced during the segmentation of a crown. Components of restoratives and chemicals generated during setting can be harmful. After placement, thermal shock and galvanism can cause hypersensitivity. Bacteria penetrating along the tooth-restoration, interface may contribute to pulpal irritation, as well as secondary caries<sup>[12]</sup>.

Recognizing the importance of the biological characteristics of dental materials, the American Dental Association has developed a series of tests that should provide acceptable methodology for screening materials for their toxicity and irrational characteristics. With the advent of such a specification, the dentist is assured of a specific biological index for every material used in the oral cavity, in addition to its certification as to suitability from a mechanical standpoint.<sup>[12]</sup>

**Side effects on oral mucosa and teeth (based on the type of materials):** There are many materials that are used in dentistry, so they may show numerous side effects, therefore the side effects of some commonly used dental materials are summarized in the Table 2.

Table 2: Side effects on oral mucosa and teeth (based on the type of materials)

Materials	Effects
Mouth washes, tooth pastes, impression materials (temporary materials)	Hypersensitivity reactions <sup>[17,18,19,20,21]</sup>
Amalgam	Discoloration of mucosa, gingiva, teeth <sup>[22,23,24]</sup>
Ni-Cr alloy	Discoloration of gingival <sup>[24]</sup>
Mercury (in amalgam)	Hypersensitivity reactions in gingiva, buccal mucosa, tongue, skin of the back of the hands lichenoid reaction <sup>[25,26,27,28,29,30]</sup>
MTA with CHX	Decrease the percentage of fibroblasts and macrophages in S phase (DNA) synthesis, Increase their cytotoxicity <sup>[31]</sup>
Bis-GMA	Induced a significant high embryotoxic/teratogenic effect over a large range of concentration <sup>[31,32]</sup>
TEGDMA	Evidence of a possible risk factor for tumor initiation in human salivary glands (over a large range of concentration) <sup>[32,33]</sup>
Ag-Sn alloy	Discoloration of mucosa <sup>[34]</sup>
Oral hygiene products, food additives	Contact allergy in the mouth <sup>[35]</sup>
CHX	Tooth discoloration, taste disorder <sup>[24]</sup>
Stannous fluoride	Tooth discoloration
Uncured primers and adhesives of dentin bonding resins	Cytotoxic to L 929 Cells (Monomers) clinical exposure to this materials should be minimized <sup>[36]</sup>
Denture relining materials	May be cytotoxic and irritant <sup>[37]</sup>

**CONCLUSION**

Dental materials, which have now found widespread applications in dentistry, in spite of their good physical and mechanical properties and excellent esthetic characteristics, may, in turn, cause some side effects. The side effects may lead to severe lesions in oral cavity or far from the application place of the materials. Dental materials may be categorized in two temporary or permanent materials and the related side effects can be studied based on clinical view, region, and the type of materials.

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