Brief Report

Oral diseases associated with fixed prosthodontic restorations

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A substantial proportion of dental patients use fixed prosthodontic restorations. In Europe,[1] almost half of the Swedish population and one third of the Swiss population use fixed restorations. This type of dental prosthesis is not without complications, as these restorations often extend into the gingival sulcus, and gingival epithelial cells come into contact with them.[2] Corrosion of dental alloys occurs due to reaction with oral cavity fluids and consumed food, and can lead to surrounding tissue reaction and inflammation. An immunological response may occur locally, leading to oral discomfort and reactions with varying intensities, including stomatitis and lichenoid reactions. These local reactions may be accompanied by a systemic reaction, and these sensitized cells with the metal ions may produce delayed hypersensitivity.

The reduced capability of tissues to repair with age further complicates the situation. Inflammation increases the permeability of the tissues to noxious substances and make them prone to mechanical damage. The oral environment is unique, as it is capable of initiating reactivity of metal alloys releasing them and other byproducts from the main body of the restoration. Biological reactivity of dental alloys in the oral cavity can promote adhesion of bacteria and have a direct toxic effect on tissues, as well as sub-toxic effects including allergy and autoimmune reactions. Many reports and studies in dental literature refer to these processes. Mechanical irritation due to physical presence of these appliances and pressure applied on the tissues can also lead to local tissue reactions.

There are approximately 20 elements commonly used in dental practice to form the alloys from which dental prostheses are constructed. These alloys are cast and processed in the dental laboratory into various formations.[1] Dental casting alloys are widely used in fixed prosthodontic appliances and therefore come into contact with oral mucosa for long periods of time. Ni-Cr alloy is the most popular and useful alloy for fabrication of fixed prosthodontic restorations due to its improved mechanical properties and relatively low cost. Ni-Cr and Co-Cr base metal alloys have increasingly replaced gold alloys in the fabrication of fixed metal ceramic restorations. A literature search was conducted to identify the possible oral diseases that may be caused by fixed metallic dental prostheses. The following keywords and their combinations were used to identify relevant literature written in English: fixed dental prosthesis, fixed partial dentures, burning mouth syndrome, oral pigmentation, cytotoxic effects, allergy and lichenoid reaction. This short report will discuss the 4 types of oral diseases that may develop as a result of fixed prosthodontic appliances: burning mouth syndrome, oral pigmentation, hypersensitivity and lichenoid reactions, and genotoxic and cytotoxic effects.

Burning mouth syndrome (BMS) is characterized by an unremitting sense of oral burning and pain with undetectable oral mucosa changes. Patients usually complain of a burning sensation that may affect various oral sites, but mainly the labial mucosa and the tongue. Its etiology is poorly understood, but it may be classified into a primary variant that is apparently related to a neuropathic background and a secondary variant, which may arise as a result of local precipitating factors such as contact hypersensitivity. The prevalence of BMS may be influenced by age (increasing with age), and gender (increasing in women, particularly postmenopausal women), making it difficult to state its prevalence precisely. Studies investigating the association between BMS and fixed dental appliances have presented contradictory results. Some are based on the findings of patch tests, which may confirm hypersensitivity to metals, and some are based on salivary concentrations of metals. Although a positive patch test or a high concentration of metals in saliva were not found to be correlated with BMS, a recommendation was made to conduct these tests on patients who have BMS in the presence of a fixed dental prosthesis.

Hypersensitivity and lichenoid reactions. The material used in dental alloys should be biocompatible and should not cause toxic or injurious effects when it comes into contact with living tissue. In other words, biocompatible dental materials should be non-toxic, not leach or diffuse and not be absorbed into the circulatory system, as this might cause adverse systemic effects, including teratogenic or carcinogenic effects.[2] Nickel, chromium, mercury, palladium and cobalt are all commonly used in dentistry, and all are known allergens.[1]

Nickel is a common allergen, and the incidence of nickel allergy and nickel dermatitis has been reported extensively in the literature, with nickel allergy particularly common in women. The use of nickel-

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containing materials in dentistry has been reported as a source of allergic reactions.[2] Intraorally, nickel allergy tends to manifest with symptoms including burning sensation, gingival hyperplasia and lingual paresthesia. Nickel allergy is frequently associated with chromium and cobalt reactivity. Although gold has been suggested as an alternative to nickel in allergic patients, there have also been case reports on the development of orofacial granulomatosis in response to gold dental crowns.[3] It is believed that a statistical correlation exists between extent of restoration with gold and the extent of allergic reaction; the more exposed gold surfaces in the mouth, the higher the risk of gold allergy.[4]

Palladium is another metal that has been extensively reported as causing oral lichenoid reactions; approximately 13-15% of patients with palladium sensitivity develop oral lichenoid reactions.

Oral pigmentation. Nickel alloys were first introduced as a replacement for the increasingly expensive noble alloys and became popular for their substructure and properties. As the oral environment is so complex, these alloys continuously corrode and ions such as (Ni^{+3}) may be released as long as the alloy is in use intraorally. It has been claimed that the development of oral pigmentation is closely related to the occurrence of dental alloy corrosion.

Visible areas of linear pigmentation often occur immediately around the restored tooth. Silver-containing stains produce pigmentation in the vicinity of noble-metal based fixed restorations. These pigmented regions may occur due to other released metals such as silver, copper, palladium, and gold. Joska et al[5] reported finding silver and copper in the root of a tooth restored with a gold-based crown. Released metals form soluble compounds in the gingival sulcus, which facilitates their transport and deposition into underlying soft tissues.[5]

Much effort has been directed towards understanding the mechanisms involved in gingival pigmentation, but they are still unclear. Some have speculated that there is a presence of Ni or Cr in the gingival tissues adjacent to crowns made of Ni-Cr alloys, but no traces of these metals have been detected by biopsies of the adjacent tissues. Regardless of the mechanism behind oral pigmentation around fixed dental appliances, there have been no reports on the potential harmful consequences of these pigmentations apart from patients' aesthetic concerns.

Genotoxic and cytotoxic effects. Proliferation, metabolism and other functions and behavior of gingival fibroblasts become altered when the cell is exposed to released metal ions such as Ni^{+3} and Cr^{+3}. Moreover, these metal ions result in the production of increased amounts of inflammatory mediators such as Interleukin-1b, Interleukin-6, and tumor necrosis factor alpha. These metal ions have also been proven to have a cytotoxic effect on tissues as they produce DNA and RNA changes, alter protein synthesis and promote oxidative DNA breakdown, eventually leading to apoptosis.

Genotoxicity and mutagenicity of various metal ions have been investigated in prokaryotic and eukaryotic cells. There are only few in vivo studies that report on metal release from fixed orthodontic appliances and their biologic effect on the DNA of oral mucosal cells.

Genotoxicity of metal ions released from fixed prosthetic dental restorations was confirmed after investigating the commonly used Co/Cr/Mo and Ni/Cr casting alloys. Released metals might be responsible for DNA damage of oral mucosal cells. On the other hand, Ni-Cr alloys were reported to be more cytotoxic than Co-Cr or Au-Pt alloys.[2]

The main limitation of this study is that it comprises only reports of possible complications that can arise from fixed prosthodontics appliances, with no data on their prevalence, or incidence rates.

In conclusions, fixed dental appliances may be associated with some oral disorders. Patients complaining of the above mentioned disorders should be screened by their general practitioners and general dental practitioners for intraoral prosthetic appliances. Patch tests can be reliably used to confirm metal allergy. This test involves the application to patients' skin of a certain concentration of a suspected allergen in a solution or ointment. For example, if nickel allergy is suspected, diagnosis is confirmed by a patch test using 5% nickel sulphate in petroleum jelly.

Dentists should be mindful of the potential that metal alloy corrosion can release metal ions. They should also appreciate the allergy-producing potential of fabricated alloys and take appropriate measures to reduce the risk of allergic reactions. Hypersensitive patients should be identified with patch tests, and the simultaneous use of different alloys in the mouth is discouraged. It may be useful to modify the treatment plan when any of the above diseases is encountered following the fabrication of fixed dental appliances utilizing metallic components.

This study is only a preliminary review on the subject. More research is needed in the form of cohort studies to investigate the incidence of oral diseases arising from fixed prosthodontics appliances, as well as cross-sectional surveys to investigate the prevalence of such diseases.

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