Nickel and Dental Alloys

Nickel Stewardship

A wide range of materials are used in routine and cosmetic dentistry, including metals and their alloys, polymers, ceramics and composites. Dental applications of metals and alloys include fillings, prosthetic devices (crowns, bridges and removable prostheses), dental implants and orthodontic appliances.

Nickel is found in many alloys used in dental treatment to provide improved physical and chemical properties, such as strength and durability, as well as to reduce the cost of using precious alloys such as gold. The amount of nickel in any dental alloy can vary from a few per cent to over 60%. Nickel alloys are recognised for their ability to withstand the harsh oral environment and have a long-standing history of successful use in dentistry.

Nickel dental alloys are used in the construction of long-term restorations designed to remain in clinical service for many years, including crowns, fixed bridges and removable partial dentures. They are also used for shorter-term applications, such as in orthodontic appliances to move and straighten teeth.

Nickel is a common allergen and the use of nickel-containing materials in dentistry has sometimes been reported as a source of adverse reactions. This advisory note aims to provide reassurance and advice about the safe use of nickel as part of an alloy in dental materials.

Assessing the risk

The range of materials used in dentistry is large and includes a number of known allergenic substances of which nickel is only one. In several cases adverse reactions can often be explained by the trauma of the original work, poorly fitting appliances or by infection – not the material itself.

There have been occasional reports of biological effects relating to the use of nickel alloys in dental applications. The reports are generally of patients with a pre-sensitisation to nickel who, following the insertion of a nickel-containing orthodontic device, developed a form of contact dermatitis.

Importantly, there is no evidence that patients are at significant risk of developing sensitivity solely due to contact with nickel-containing dental appliances and restorations. Allergic reactions are more likely to occur with prior sensitisation from non-dental contacts. Conversely, it seems that early dental and non-dental oral contacts with the metal or metal compounds may even induce tolerance and result in a lower prevalence of nickel sensitivity in non-sensitised individuals.
The amount of nickel in dental alloys is not indicative of the amount of nickel that might be released when the material is in the mouth and in contact with surfaces or with saliva: different alloys have different levels of corrosion resistance and hence different levels of nickel release.

For example, studies in the dental literature show that the amount of nickel released from nickel-chromium dental alloys is strongly influenced by the content of chromium and beryllium in the alloy. A chromium content of below 15% leads to increased metal ion release in all alloy components, including nickel, since the chromium share is not sufficient to passivate the entire surface. The addition of beryllium in the alloy – even minor amounts – also leads to increased ion release.\(^1\)

Nickel-chromium dental alloys that are beryllium-free and contain a minimum chromium content of 20% prove to be adequately resistant to corrosion, even under extreme experimental conditions. These high quality dental alloys release very low levels of nickel ions: up to 15 μg per dental crown per day, which is well below the normal range of 100 – 600 μg of nickel ingested daily through food.\(^2\)

Controls on the use of dental alloys should therefore be based on an assessment of the level of total metal ion release (including nickel), and not on nickel content.

**Recommendations**

**For dental practitioners:**
- Ascertain whether the patient has a history of nickel allergy, and if so, avoid using nickel-containing alloys.
- Select high quality dental alloys. For the case of nickel-chromium alloys, select those that are beryllium-free and contain over 20% chromium.
- Ensure that dental technicians who are responsible for preparing dental alloys receive proper materials handling training. Improper melting, casting or heat treatment of an alloy can affect the quality and corrosion resistance of a dental restoration.

**For dental patients:**
- If you have an allergy to nickel, discuss this with your dentist before a material is chosen for restoration, surgical or orthodontic dental work. Advice for consumers on this and other subjects is also available on our website www.nickelinstitute.org.

**NI policy and practice**

As part of our overall Nickel Stewardship programme, the Nickel Institute has invested in research into the safety of nickel containing dental alloys. A literature review was published in 2006 and concluded that “Nickel is found in many alloys used in the practice of dentistry. These alloys have a long-standing history of successful use in dentistry, with no significant reports of biological effects.”\(^4\)

The industry remains committed to ongoing review given the importance of nickel to the development of optimal quality dental alloys. We are committed to periodically providing a contemporary, comprehensive and evidence-based review of the existing knowledge and understanding of the biological reactions to, and the safety of, nickel in dental alloys with an emphasis on recent publications in the field.

If you have an allergy to nickel, discuss this with your dentist before a material is chosen for restoration, surgical or orthodontic dental work.