

An Assessment of the Components of Dental Implant Materials

Dental implants have been developed to replace diseased or damaged teeth. Whereas traditional dental materials, such as gold crowns or mercury-containing amalgams, are well known causes of allergic contact dermatitis (ACD), dental implants are often made of titanium alloys. Dental implants consist of 3 parts: a fixture, an abutment, and a crown. During the surgical phase, the fixture is inserted into bone and is fitted with a healing cap during osseointegration. Once the tissues heal (approximately 4 months), the cap is removed and replaced with an abutment onto which a crown or a bridge is mounted.

In 2019, the dental implant industry had a market value of more than \$4 billion and is estimated to grow by 5% annually between 2020 and 2026.¹ Case reports of ACD manifesting as localized mucositis or burning mouth symptoms to titanium, palladium, or cobalt have been reported.²⁻⁴ In vitro and in vivo studies have shown that titanium alloys are susceptible to corrosion in the oral environment and, in the process, release metal ions to the peri-implant tissues.⁵ However, a study of cobalt implants did not show the same phenomenon.⁶ In sensitized individuals, these ions have the potential to cause a localized ACD.

The purpose of this study was to identify the materials used by dental implant manufacturers. We used Zest Dental Solutions, a

dental supply company, and Country Dental, a trade website, where we identified 34 companies producing 46 implant systems. We pulled safety data sheets from these companies and tabulated the components used in their implants. Notably, 8 implant systems did not produce and/or list the components of their caps.

The contents of the fixture, healing cap, and abutments of 46 implant systems are shown in Table 1. Titanium was the most common material for all 3 implant components. Most fixtures (78.2%) and healing caps (76.3%) were made exclusively of titanium. In contrast, only 26.1% of abutments were 100% titanium. Abutments were more likely to be metal alloys or composites of metals and synthetic materials, such as polyetheretherketone. Interestingly, gold and cobalt, which are known mediators of ACD, were found in 34.8% and 17.4% of abutments, respectively.

The frequent use of titanium among dental implants may result in less ACD than if other metals were used. However, ACD to titanium is possible, and there is concern that patch testing may not detect all cases.⁷ When a titanium allergy is suspected, a ceramic implant containing zirconium dioxide should be recommended.

Limitations of this study include that we may not have assessed all commercially available implant systems. However, we systematically assessed systems listed by a large implant distributor and a trade organization. The implants may also contain trace amounts of other metals that were not listed by the manufacturer.

TABLE 1. Dental Implant Contents

| Material | Fixture | | Abutment | | Cap | |
|--------------|---------|------------|----------|------------|--------|------------|
| | Number | Percentage | Number | Percentage | Number | Percentage |
| Metal | | | | | | |
| Titanium | 42 | 91.3 | 39 | 84.8 | 34 | 89.5 |
| Aluminum | 1 | 2.2 | 1 | 2.2 | 0 | 0.0 |
| Vanadium | 1 | 2.2 | 0 | 0.0 | 0 | 0.0 |
| Zirconium | 6 | 13.0 | 13 | 28.3 | 0 | 0.0 |
| Gold | 1 | 2.2 | 16 | 34.8 | 3 | 7.9 |
| Cobalt | 0 | 0.0 | 8 | 17.4 | 0 | 0.0 |
| Molybdenum | 0 | 0.0 | 1 | 2.2 | 0 | 0.0 |
| Other | | | | | | |
| Ceramic | 1 | 2.2 | 2 | 4.3 | 0 | 0.0 |
| Plastic | 1 | 2.2 | 6 | 13.0 | 2 | 5.3 |
| PEEK | 0 | 0.0 | 18 | 39.1 | 7 | 18.4 |

PEEK, polyetheretherketone.

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With the growing use of dental implants, there may also be an increase in rates of ACD to their materials. Although rare, ACD to the implant materials may cause a localized mucositis that improves with removal of the offending implant.^{2,3} If concern or evidence of a titanium allergy exists, a zirconia ceramic implant

may be safer. Similarly, abutments containing cobalt or gold should be avoided in sensitized individuals.

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