



REVIEW ARTICLE

DENTAL IMPLANTS TOXICITY – A REVIEW

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ABSTRACT

Implant therapy currently promises a good, long-term treatment result without impacting health; however, its success depends on many factors. Titanium is the most widely used inert bio-material for dental implants due to its excellent mechanical strength and biocompatibility. But in some cases there are reports of problems caused by titanium like corrosion, biofilm formation, Titanium-induced hypersensitivity which can lead on to implant rejection. To avoid hypersensitive reactions to metallic dental implants, precautionary principles for primary prevention should be established. For medical purposes, it is important to define and discuss the characteristics of metals used in implantable devices and to ensure their biocompatibility.

INTRODUCTION

The target of current implant dentistry is to re-establish aesthetics, physiological function, speech, comfort, and health to patients who have missing teeth.⁽¹⁾ The tooth loss is commonly caused by decay, inflammatory loss of periodontal tissue, failed root canal treatment, or through fracture of teeth.^(2,3) For replacing missing teeth, implants are one of the methods. Implants were first put forward in the year 1960s by Branemark, a Swedish scientist, and he described osseointegration. Later this has been followed by the advance of numerous implant systems.⁽⁴⁾ Dental implants are commonly made of titanium alloys.⁽¹⁾ The biocompatibility defined as the compatibility of a material with a living tissue or system by not being toxic, harmful, physiologically reactive or including immunological rejection.^(5,6)

Thus titanium implants are biocompatible, but it has adverse effects too. Implant therapy promises a good long-standing result without impacting health, but Titanium-induced hypersensitivity, Corrosion and biofilm formation lead to symptoms of implant rejection.⁽¹⁾ Here we discuss the characteristics of titanium metal used in dental implants and its toxicity.

Titanium

Titanium is an inert dental material. This metal is used as oral implants, it forms an oxide layer on exposure to oral fluid.⁽⁷⁾ As a result, the formed titanium dioxide (TiO₂) or zirconium dioxide (ZrO₂) act as a boundary in between the oral medium and metal structure.^(8,9) Separation of oxide layer leads to corrosion of this metal and release them into the oral

cavity.^(9,10,11) Collections of titanium ions are present in the tissues particularly in lymph nodes locally and in pulmonary tissues. Collection of titanium particles inside the macrophage lysosome reports to show hypersensitivity reactions.⁽¹²⁾ Frisken et al conducted an implant failure study, in that study two implants expresses without any infection, but there is existence of titanium in the lungs which is 2.2–3.8 times higher than normal.⁽¹³⁾ Various types of biomaterials are used as particle coatings to the dental implant surface to enhance soft tissue integration and thereby enhance dental implants victory. The types of nanoparticles with ability to induce a chemical bond with bone to advantage an ideal biological fixation were applied as coating of dental implants. The investigators are trying to improve bone incorporation of dental implants using nanoparticles as dental implant coatings. Though, the same properties of nanoparticles which progresses the functionality may also display unknown adverse effects, like instability because of nano-coating or cellular nano-toxicity.⁽¹⁴⁾ Titanium has convenient mechanical properties such as its high strength-to-weight ratio, malleability and low density.⁽¹⁾ Titanium oxidizes immediately on exposure to air, forming a thin titanium dioxide (TiO₂) layer, through its self healing effect, it quickly reforms if damaged, provided there is sufficient oxygen in the surroundings.⁽¹⁵⁾ Titanium is a nontoxic and infrequently rejected by the body. It has its inherent capability to osseointegrate and thereby enabling its utilization as a dental implant material which stays in place for several years.⁽¹⁾

Titanium Implants Toxicity: Titanium induces clinically relevant hypersensitivity reactions and other immune dysfunctions.⁽¹⁶⁾ Pure titanium, in controlled environments, it is corrosion-resistant and also in the load absence.⁽¹⁷⁾ In oral conditions and in with cyclic loads, titanium corrodes, by affecting the mechanical stability of an implant.⁽¹⁸⁾ Many types of corrosion were associated with metallic implants, like galvanic, fretting, pitting, and crevice corrosion.⁽¹⁹⁾ Other adverse concerns are metal ion release, allergic responses and biofilm formation.⁽¹⁾ The metallic debris which produced after implantation induces an enhanced inflammatory response, contributes to a hypersensitivity reaction.⁽¹⁹⁾ Metal hypersensitivity is commonly a type IV hypersensitivity and it is a delayed hypersensitivity, since the reactions takes place in 48 to 72 hours to build up.^(20,21,22) Metal hypersensitivity manifests as chronic inflammation and pain. The symptoms of metal hypersensitivity include fatigue, depression, or fibromyalgia. In this scenario, the pain will be in patient without a known cause. The most common clinical manifestation of a patient with a metal allergy is lichenoid reactions, expressed as oral lichenoid lesions. All these types of symptoms occur in metal implants patients who are chronically exposed to metal allergens. The metal implants are rejected without any evidence of a previous hypersensitivity reaction.⁽²³⁾ Melisa test is able to define which metals are tolerated or induces an undesirable immune response in the sensitive patient.^(24,25)

CONCLUSION

Titanium or its alloys are widely used and promotes osseointegration, with some concerns such as metal ion release, allergic responses and biofilm formation. Dentist should be aware of the rare problems of titanium toxicity. The definitive treatment for confirmed titanium hypersensitivity reaction is the removal of the device; however, medical

management is possible in some cases.⁽¹⁾ Currently, zirconia implants are considered to be an alternative; however, there are still limitations due to a lack of long-term clinical data.

CONFLICT OF INTEREST : NIL

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