

## What is an ideal solution for the allergic symptoms by existing titanium implants in dentistry? How do many suitable replacements exist? – a review.

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### ABSTRACT

As nanoparticle titanium dioxide, titanium dioxide dust, when inhaled, has been classified by the International Agency for Research on Cancer (IARC) as an IARC Group 2B carcinogen. The International Agency for Research on Cancer (IARC) is a part of the World Health Organization WHO). To prevent making nanoparticle titanium dioxide from the corrosion of dental implant fixture, the author is introducing two-layer coating system for controlling corrosional toxicity of TiO<sub>2</sub> from the surface of dental implant fixture by medronic acid and teriparatide acetate.

**Keywords:** Carcinogen, Titanium, Oxidation, Titanium Dioxide, Implant, Fixture, Allergy, Medronic Acid(MethyleneDiPhosphonic(MDP)), Forteo (Teriparatide Acetate), UV, Zoledronic Acid, Imidazole, Coating

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### I. INTRODUCTION

Titanium has widely used as prosthetic materials for dentistry for last around 30 years. But Titanium has its native defect as a public carcinogenic material classified as a member of group 2B by International Agency for Research on Cancer (IARC). In response to its defective pathological potentiality, titanium has made many pathological symptoms like allergy, urticarial, eczema, edema, dermatitis, necrosis and facial erythema. In case of titanium in dentistry, mostly used as the main source of fixtures of dental implants and they are easily corroded by saliva, fluoride in the toothpaste, acidic food and soups with hot temperature. If the fixture is exposed partially by the recession of gums and alveolar bones, the corrosional reaction accelerated by having more chance to contacts the bolus, its fluid and the air. Moreover, titanium is highly actively oxygenated metal in the room temperature and finally oxygenated titanium after forming oxide film of 4nm thickness begins to show toxicity including allergic reactions. In detail, the thickness of this oxide film increased sequentially and oxygen ions from the firstly formed monolayer move to metal and react with the surface of the titanium fixture in the base of oxide film. These oxidative titanium

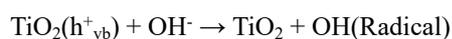
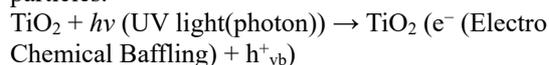
particles found in the nearer alveolar bones, oral cavity limp nodes and lungs. Corrosional toxicity of TiO<sub>2</sub> has been reported numerously for many years, and it includes genetic damage, carcinogenic, yellow nail syndrome, implant failure, inhibition of apatite formation, and allergic contact dermatitis [1-9]. From the cases of physiological problems shown in markers of oxidative stress and inflammation in plasma, urine, and exhaled breath condensate [10], some cases were appeared with dermatological allergies [11] and others induced osteoporosis near the implanted fixtures in the alveolar bone of the patient. Dermatological toxic reactions from implant fixtures from Nobel Biocare, USA in a Japanese patient has been decreased after extraction of the implants [12]. But there wasn't a report of natural healing reactions after extraction of implant fixtures [13].

### OBJECTIVE

**Toxicological Reaction of titanium implants in Chemistry.** A refined metal used to be changed into a more chemically-stable form such as oxide, hydroxide, or sulfide. In dentistry, strong oxidizing agents can easily remove electrons from pure Titanium (Ti) and be connected with oxygens (O<sub>2</sub>) by accepting these removed electrons. The most

important ingredient of teeth whitening gel is the main oxidizer in tooth whitening treatment in dental clinics before carbamide peroxide gel. Fluoride (F) calls strong oxidation of the exposed part of Ti implant fixture to saliva after the patient brushed teeth with any kinds of tooth paste. Also, the salty foods of our daily diet like sausage and cheese are the main source of chloride (Cl) after being manufactured by adding sea salt promotes the corruptions. Olives, lettuce, seaweed, tomatoes, celery, and rye, the main source of breads have higher amounts of chloride (Cl) than other dietary sources. All summed amount of chloride (Cl) from these foods are accumulated and solved by the saliva of eater and stayed longer in the interproximal gums with the chunk of the food with wedge shapes and begins oxidation of titanium fixture of implants from the top of the fixture. If an implanted patient enjoys beer or cola, the life of the fixture will be shorter than expected by corrosion.

The main reason of the toxicity of titanium dioxide is from hydroxyl radical formation [14]. Corroded particles of  $TiO_2$  absorbs ultraviolet radiation ( $h\nu$ ; photon) and separates electric charge, excites electron to the band of conduction and generate active hydroxyl radicals by oxidation of water molecules near corroded particles of  $TiO_2$  with having photo-generated holes and oxygenated species harming the nearest tissue from these particles.



Human Tissue + hydroxy radicals  $\rightarrow$  Allergic and toxicological reactions of the tissue  
On the other hands of the corrosion by reduction, titanium fixture is also vulnerable. else highly electronegative elements ( $O_2$ ,  $F_2$ ,  $Cl_2$ ,  $Br_2$ ) that can gain extra electrons by oxidizing another substance.

### Objective:

**Why the implants are necessary in dentistry?** After tooth extraction, dental implants preserve natural tooth tissue and there is no need to cut adjacent teeth for conventional dental bridge. They also preserve alveolar bone and significantly reduce bone resorption and deterioration leading to loss of jaw height, which will be the main cause of malocclusion. If the implant is not performed, the surrounding teeth are pushed into the extracted space and the teeth are disorganized, and the patient cannot have a normal occlusion and condylar

cartilage connecting mandible and maxilla will be worn irregularly and cause pain.

## II. DATA AND SOURCES

### Examples of applicable implants

#### 1. By locations

**Endosteal:** This dental implant is placed inside of the alveolar bone of the maxilla or mandible. It is usually made of titanium and is the most commonly used type of implant with a small screw shape [15].

**Subperiosteal:** These dental implants are fixed under the gingivae, but implanted above the alveolar bone. This type of implant can be used in patients who do not want to have alveolar bone augmentation before implanting fixtures [16,17] or patients want partial orthodontic treatment for correcting positions of strong rooted teeth like molars.

#### 2. By working time

**In a day implant:** It places temporary crowns as the patient have enough natural bones and for patients needing to support immediate placement and pressure on their new temporary teeth.

**Classical implant:** Usually, the total treatment and healing time for implant placement is divided into 5 stages for 3 to 6 months. This is for the titanium root of the existing implant to integrate with the alveolar or cancellous bone by osteal adhesions.

#### 3. By size:

**Mini Dental Implant (MDI) for restoration or dentures:** Toothpick-sized implants, also known as small-diameter or narrow-diameter implants having a diameter of around 1.8 mm are narrower than the normal dental implants with 3.5 mm diameter. It is placed through a less invasive technique and is mainly used to stabilize the lower denture or partial orthodontic treatment of a tooth for one directional correction.

**Mini Dental Implant (MDI) for orthodontics:** Mini implants used for orthodontics do not need metal housing and O-rings for restoration of the crowns but implanted on the free gingiva not attached gingiva.

**Common Implant (CI) for restoration:** Implant diameter ranged from 3.0 to 5.0 mm [18].

#### 4. By the number of implant fixtures

**Single implanting:** The average healing time for a dental implant is 6-8 months before 'complete healing' occurs before the final tooth is inserted.

**N-implanting:** It is implanting N (more than 4) dental implants on the available bones with no need for bone grafts. A set of temporary replacement teeth can be placed on the same day using a special abutment. It follows a modified diet while the gum tissue heals and the implants engage with the natural bones. After about 6 months, the patient can place a permanent replacement tooth and resume regular eating.

### III. STUDY SELECTION

**Various used materials for implants** Titanium (Ti) and its alloys (mainly Ti-6Al-4V aka Ti grade 6) have become the metals of choice for dental implants.

- Application of titanium implants in dentistry as fixtures or dentures?

Dental implant of titanium implant has biocompatibility with bone structure. It can be applied anywhere in dentistry for osseointegration as a fixture and denture [19].

- Toxicity and danger arising from the use of titanium implants

Yellow nail syndrome, allergic reaction, erythema, urticaria, eczema, swelling, pain, necrosis [20], and bone loss due to titanium dental implants. acute disease, cancer, autoimmune diseases. It is not considered a toxic metal but it is a heavy metal and it does have serious negative health effects. Titanium has the ability to affect lung function causing lung diseases such as pleural disease [21], it can cause chest pain with tightness, breathing difficulties, coughing, irritation of the skin or eyes.

- Various solutions introduced to minimize the toxicity of the titanium implant

It is necessary to coat the surface with non-allergic materials having osseointegrating functions. The possible ways of coating are inorganic coating by non-allergic metals as tantalum or cerium or organic coating with non-allergic materials which can prevent the possible redox reaction which is the major source of allergic reaction from the titanium of the surface of the implant. Some chelate structured agent is fit to this condition, porphyrin and glutathione. Also, it's applicable to try endodontic materials MTA (Mineral Trioxide Aggregate), HA (Hydroxyapatite) to stop redox reactions. Further it's necessary to induce osseointegration. Teriparatide is applicable to coat the surface.

### IV. CONCLUSION

#### Critical summarization of using of titanium

To get enough shearing strength for mastication between an artificial tooth and antagonist teeth, titanium has been an indispensable choice. But now many medical results show the allergic reactions of titanium to human body and it's necessary to coat it with non-allergic materials above.

#### Conflict of Interest

"The author(s) declare(s) that there is no conflict of interests regarding the publication of this article".

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