



Review Article

A literature review on different types of surface treatment in implants

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ABSTRACT

In a present scenario, dental implants are becoming very popular in day to day practice and is one of the most promising treatment modality in the procedure of replacement of missing tooth or teeth in the oral cavity. There are various factors over which the success of implant therapy depends, such as local as well as systemic factors, like age, bone availability in terms of height and width, bone density, any local infection present, systemic disease, and some other factors like implant design, implant surface, which plays an important role in the process of osseointegration.

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1. Introduction

In the present time dental implants are one of the most commonly used treatment modality in the treatment of rehabilitation of partially and completely edentulous arches. Treatment modality with implants promised with much better results as compared to treatment modality of conventional denture with prime focus on preservation of the alveolar bone and esthetics as well as durability of the prosthesis as major concern. Dental titanium implants have the ability to get anchored with the alveolar bone by a process known as osseointegration. There are several factors that plays a major role in the process of osseointegration for example, length of the implant, surface topography of the implant. Osseointegration of the titanium dental implant can be enhanced by different ways by changing or by making surface modification over the surface of the titanium dental implant. There are different types of surface treatment or modification in titanium dental implant such as physical, chemical and mechanical.¹⁻³ By surface medication there

occur increase in surface energy, which leads to increase proliferation of cells and growth factors which finally leads to increased to the process of osseointegration. According to a study they stated that, if there is increase in roughness over the implant surface, there is increased in the surface area that will ultimately lead to increased cell proliferation as well as cell growth.⁴ Any additional coating over the implant surface finally leads to increased the surface area of the implant, which ultimately leads to the good implant osseointegration with the alveolar bone.⁵ Due to excellent biocompatibility of the titanium, its high resistance to corrosion, high strength, along with low modulus of elasticity, it was found to be the material of choice for the dental implant. Surface modification over the implant surface is basically done to achieve good osseointegration, which ultimately leads to shorter the healing time and thus leads to shorter duration of treatment plan. Surface modification of the implant can also be achieved by the process of acid etching and as well as through sand blasting.⁶ The prognosis of treatment by dental implant is totally dependent over the biocompatibility of the material being used. Literature revealed that titanium and its alloys

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found to be the best material of choice for the dental implant therapy as the basic advantage of titanium and its alloys are they promote the process of osseointegration and simultaneously well tolerated by the living tissue and by the alveolar bone. The basic principle of doing the surface modifications over the implant surface is to enhance the bonding between the two i.e. the alveolar bone and the implant material. The surface of the material should be able enough to make the contact between the alveolar bone and the implant material, after the surface treatment. The surface modification of the implant surface leads to a promising way for the process of early osseointegration of the implant to the alveolar bone, and thus reducing the total time period of the treatment plan. There are different surface conditions which may lead to better osseointegration like, roughness over the surface, surface charge, and finally the composition of the material.⁷ Different authors stated that, by increasing the surface energy of the implant material and by increasing the roughness over the implant material, faster results in case of osseointegration has been observed.^{7,8} Surface modification or otherwise known as surface topography can be broadly classified into two categories i.e. i) is macro topography and ii) is micro topography. Under macro topography, it basically deals with the shape of the titanium dental implant, length of the titanium dental implant, width of the titanium dental implant, geometry design of the dental implant, whether the implant is threaded or non threaded. Under micro topography, there is physiochemical modification, bio chemical modification and the last the morphogenic modification. Physio chemical modification basically deals with the process of tissue integration to the titanium dental implant, by altering the surface energy, surface charge and surface composition of the titanium dental implant. Under morphogenic modification, there occur the alteration in morphology of the dental implant surface, to increase the process of adhesion by the process of mechanical or chemical adhesion to the implant surface. And the third process is by biochemical modification over the surface of titanium dental implant, by the use of specific enzymes along with proteins. The bio chemical modification is done by interaction between molecules by the process of chemical adhesion and by interleukin 1, growth factor 1,2, platelet growth factors and by the use of bone morphogenic protein. Along with it morphogenic modification can be done by the process of additive techniques that utilizes the principle of sintering of the implant surface, spraying of plasma over the implant surface, by the process of anodization. Subtractive technique include the sand blasting or the grit blasting of the surface of the implant, by the process of acid etching, laser sintering, along with dual acid etching. The third technique is by nano modified technique is by implantation of ions by deposition of ion beam, coating with nano crystals coating that constitutes of calcium phosphate coating over the surface of the implant

and also by hydroxyapatite coating over the surface of the implant. By the use of all these methods, one can enhance the process of osseointegration between the dental implant and the alveolar bone.

1.1. Various principles through which surface modification can be done are as follows

1. Coating of plasma spray over the surface of the implant.
2. Grit blasting
3. Through the process of acid etching.
4. Through the process of dual acid etching
5. Sand blasting along with acid etching
6. Laser peening
7. Direct metal laser sintering
8. Through the process of anodization
9. Through the process of electrophoretic deposition
10. Application of biomimetic agent.

1.2. Coating of plasma spray over the surface of the implant

This technique basically involves the deposition of layer, which is thick in consistency, for e.g. deposition of layer of hydroxyapatite, in this process thermally melted material being sprayed over the surface of the implant. Mixture of hydroxyapatite with titanium alloy material attract attention due to the property of excellent biocompatibility.⁹ Plasma spray increases the surface energy, by making the surface of the implant rough and ultimately increases the surface area.¹⁰ According to a study they reported that, the implants treated with hydroxyapatite solution, eventually decreases the healing period after implant placement, when compared to the implants that are uncoated.¹¹

1.3. Grit blasting

Another technique for making the surface of the implant rough, is by the process known as grit blasting, by projecting the particles of either silica or ceramic material over the surface of the implant at higher pressure. Different materials like hydroxyapatite, titanium oxide, are usually used in the process of grit blasting.^{12,13} The process of grit blasting should always be followed by the process of acid etching.

1.4. Acid etching

Surface modification over the surface of the implant can also be done by the process of acid etching. In this technique the use of acids over the surface of the implant is not done only for the purpose of cleaning but for making the surface of the implant rough also. Various acids such as nitric acid, hydrofluoric acid and sulphuric acid can be used in the treatment via acid etch technique. Literature shows that the acid etched treated surface of the implants shows better

results in terms of cell adhesion over the implant surface and thus helps in faster bone formation.^{14,15} the rate of etching is totally dependent upon the concentration of the acid used.

1.5. Dual acid etching

The process of dual acid etching over the metal surface is to treat via chemical or with the help of acids, either in the sequence or with combination of both. A study in the literature revealed that, the implant surface treated with acid shows higher value of resistance, when the reverse torque is being applied to the titanium dental implant, while removing. According to a study, histo morphometric section concluded that, the bone to implant contact do significantly increased in case where the acid etched surface treated implant is used.¹⁶

1.6. Sand blasting along with acid etching

In this method, macro roughness and micro pits are simultaneously developed. Surface erosion is induced by the application of strong acid over the already blasted surface. In this process blasting is done by large grit particles along with acid etching that too sequentially. This process results in increasing of surface energy along with increased surface area over the implant surface, that ultimately leads to better osseointegration of the implant to the alveolar bone.^{17,18}

1.7. Laser peening

In this technique we used laser of nano seconds pulses, which strike over the metallic outer layer of implant surface. The chances of thermal as well as mechanical deformation is very much low in this process.

1.8. Direct metal laser sintering

In this technique an object is built by incremental basis or by adding layer on layer basis. With the help of metal that is powdered.

1.9. Anodization

In this process films of oxide is being deposited over the outer surface of the titanium dental implant by the means of electro chemical deposition. Anodized surface results in strong reinforcement of titanium dental implant to the alveolar dental bone.

1.10. Biomimetic agent

Various biomimetic agents like hydroxyapatite, calcium phosphate ions, bone morphogenic proteins, type collagen1, fluoride and chitosan polymer can be used as a biomimetic agent to increase the surface area.

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2. Conflicts of Interest

There are no conflicts of interest.

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