



## A LITERATURE REVIEW ON FACTORS AFFECTING OSSEOINTEGRATION IN DENTAL IMPLANT

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### Abstract :

In today's time people are very much concerned with the esthetics problem which occurs due to loss of permanent tooth or teeth either they are congenitally missing or either due to trauma. Rehabilitation of lost tooth or teeth can be done with various prosthetic modalities which includes removable prosthesis, fixed prosthesis with the help of adjacent teeth and with the help of fixed implant prosthesis. To achieve the support with the use of implant is based on the phenomenon of osseointegration. There are various factors that affect the process of osseointegration and that finally leads to the failure or success of the fixed prosthesis supported with the help of the implant.

**Keywords:** implants, fixed prosthesis, implant supported fixed prosthesis, fixed dental prosthesis, osseointegration, removable prosthesis.

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**Introduction : -**

From the past two decades, dental implants are becoming the prime most choice in the rehabilitation of the missing tooth or the teeth. The success of the implant is dependent on a bio technical process which is known as the osseointegration. For the placement of an implant in to the fully edentulous arch or in to the partial edentulous span require a minor oral surgical procedure, in which a foreign body i.e. an implant is being placed in to the alveolar bone, after the placement of the implant in to the alveolar bone a poorly organized woven bone start surrounding the implant in the initial time, after the period of three months poorly organized woven bone which is having low strength is replaced by lamellar bone which is having good or adequate strength for the process of load bearing<sup>1-8</sup>. The process of osseointegration does not alone depend on implant, its shape, dimension of implant, surface topography of implant but also depends on the surgical technique, quality of bone, amount of bone available in terms of bone height and bone width, whether single stage protocol is followed or two stage protocol is followed, whether the implant is loaded conventionally after a time period of three to six months or the implant is loaded immediately, whether the implant is placed conventionally i.e. after two to three months of extraction or the implant is placed immediately during the time of extraction. These are all the factors that affects the process of osseointegration in the success of the dental implants. Professor Per – Ingvar Branemark firstly described the process of osseointegration and the various applications of osseointegration in to the clinical dentistry. With the advancement in dentistry and due to high expectation, implants are being loaded immediately. This immediate loading of the implant can only be achieved only after the implant is properly osseointegrated in to the alveolar bone. Besides every thing the success of the dental implant is maintained by the maintaining the good oral hygiene near the implant and maintaining the good implant periodontal health<sup>9-15</sup>.

Different materials used in the fabrication of the dental implants are titanium and titanium alloys, which are having low weight and high strength with low modulus of elasticity, highly resistant to corrosion, and shows best biocompatibility with the surround bone structure. The most commonly used alloy is titanium 6 aluminum and 4 vanadium is composed of ninety percent of titanium and six percent of aluminum and four percent of vanadium. Other materials than titanium was

cobalt chromium molybdenum based alloys, iron chromium nickel based alloys, after than ceramics are also used in the fabrication of the dental implants, the main limitation of the ceramic implant were low ductility and brittleness of the material, zirconia, it is a ceramic material which is used as a material of choice as it is biocompatible, having mechanical properties better than alumina, they posses high resistance to corrosion, flexion and fracture. Out of all the above said materials pure titanium is the best material of choice for implants<sup>11-19</sup>.

**Molecular events that occur in the process of osseointegration**

It has been stated that when the implant which is made up of titanium material is exposed to the air, a very thin layer of titanium oxide is formed on the outer surface of the titanium i.e. over the implant, which helps in protecting the highly reactive surface of the titanium from the biological attack and also improving the strength and wear resistance of the titanium. The outer layer of titanium oxide also helps in the bio mineralization of the implant by letting the calcium and phosphate ions absorbs on the surface. osseointegrated events are sub divided in to three phases, first is, when the implant is incorporated in to the bone, there will be formation of woven bone around the implant, after than in the second stage is the stage of bone mass adaptation, and finally the third stage is the bone structure adaptation to the load, it is characterized by lamellar bone surrounding the implant and is having adequate strength for load bearing<sup>12-19</sup>.

**Factors determining success and failures in the process of osseointegration are as follows : -****Geometry of the implant : -**

Bone has the tendency to grow preferentially on the elevated extension of the implant body like edges of the threads, moreover the shape of the implant also plays an important role in the process of osseointegration as it governs the surface area available for the transferring of the stresses and for the primary stability of the implant. Implant those are of threaded geometry offers greater surface area as compared to the implants which is having smooth surface design. As compared to the smooth surface implant threaded implants are rigidity fixated in to the alveolar bone therefore it also limit the microenvironment during the phase of bone healing. On the other hand implants those are having smooth surface design require additional treatment of the outer surface of the implant along with in smooth surface implant additional taper is required and when it is

incorporated in the implant it results in the reduction of the surface area of the implant, which is required for the process of osseointegration<sup>22-28</sup>.

#### **Micro design of the implant : -**

Implants are made up of titanium material, and titanium is highly reactive and forms a passivation layer of titanium oxide, which is totally compatible with the surrounding alveolar as well as periodontal tissue. Surface treatment which includes sandblasting with aluminum oxide and titanium oxide helps in better adhesion, proliferation and differentiation of the osteoblasts. Similarly smooth surface titanium implant which is plasma sprayed helps in increasing the area of bone implant interface up to six hundred percent and helps in promoting the process of osteogenesis. A new technique is introduced which combines the advantages of both the techniques i.e. sand blasting and acid etching is SLA implant interface. Along with this others technique are also employed in treating the smooth surface implants which includes, anodization of the implant surface, laser treatment of the implant, and coating the surface of the **implant** with tricalcium phosphate. Tri calcium phosphate has osteoinductive property, which act as scaffolds on the implant surface and helps the bone growth around the implant. Another material which can be used as a coating material is hydroxyapatite coating. Hydroxyapatite coating helps in increasing the surface area of the implant and bone to implant interface is achieved by treating the implant surface with hydroxyapatite crystals are much more than compared to any other coating material.

#### **Width and length of the implant : -**

The greater the dimension of the implant in terms of length and in terms of width, the greater the surface area will be available for the process of osseointegration. The greater the thread depth, greater will be the surface area of the implant. One study stated that the use of short implant has not been recommended because of the belief that occlusal forces must be distributed over a large implant area in action of preserving the bone. Overall the shorter and the smaller diameter implant has lower survival rate as compared to the longer and the wider implant.

#### **Lasers : -**

The type of lasers that are used in the modification of the surface area of the implant are CO<sub>2</sub> lasers and Nd-YAG lasers. These lasers helps in surface modification of the implant as lasers has the property of melting the outer surface layer of the

implant locally. In the laser processing a newer material can be repositioned over the superficial surface of the implant. In the process of melting the substrate the heat has to be transported through the slurry of the powder which is pre positioned. If the melting point of both the materials does not differ a reasonable degree of mixture may occur.

#### **Sand blasting : -**

Sand blasting is an another alternative for increasing the surface area of smooth surface implants, so that there will be good implant to bone interface. Sand blasting can be done with materials like aluminium oxide, titanium oxide. Sandblasting also helps in the proliferation, adhesion and differentiation of osteoblasts. On the other hand fibroblast will not be able to adhere to the surface of the implant which is sandblasted, and this limits the soft tissue proliferation and ultimately results in bone formation.

#### **Surfaces sprayed with plasma : -**

Plasma sprayed implants are prepared by preparing the molten metal on the outer surface of the titanium implant. This results in forming irregular sized crevices over the outer surface of the implant and results in growth of the bone in to the crevices of the implants forming a mechanical interlock.

Different other measures are used to increase the surface area of the implant like the outer surface of the implant is treated by titanium plasma sprayed, it helps in maintaining the bone implant interface and stimulate adhesion osteogenesis. Surface area of the implant can also be increased by the process of acid etching the implant. Acid etching of the implant can be done by using hydrochloric acid, sulfuric acid, HF, nitric acid in different combinations. Another new coating can be applied over the surface of the implant known as tricalcium phosphate coating. Implant on which coating of tricalcium phosphate is coated become biocompatible, bioreactive and partially biodegradable. It shows osteoconductive properties that acts as scaffolds for new bone formation. The ingrowth of the bone in to the scaffolds results in primary anchoring of the implant. The implant coated tricalcium phosphate has enhanced properties of osseointegration.

#### **Osteogenic protein bovine :-**

When this bovine protein is inserted into the socket prepared for the placement of the implant, it ultimately shorten the time interval between the placement of the implant and the osseointegration.

**Conclusion : -**

There are various factors of osseointegration, that ultimately affects the survival or the failure of the implant. These factors are interrelated to each other. One should thoroughly know the factors responsible for the boosting the process of osseointegration and inhibiting the process of osseointegration.

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