

# Surface Treatments of Implant: A Review

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## ABSTRACT

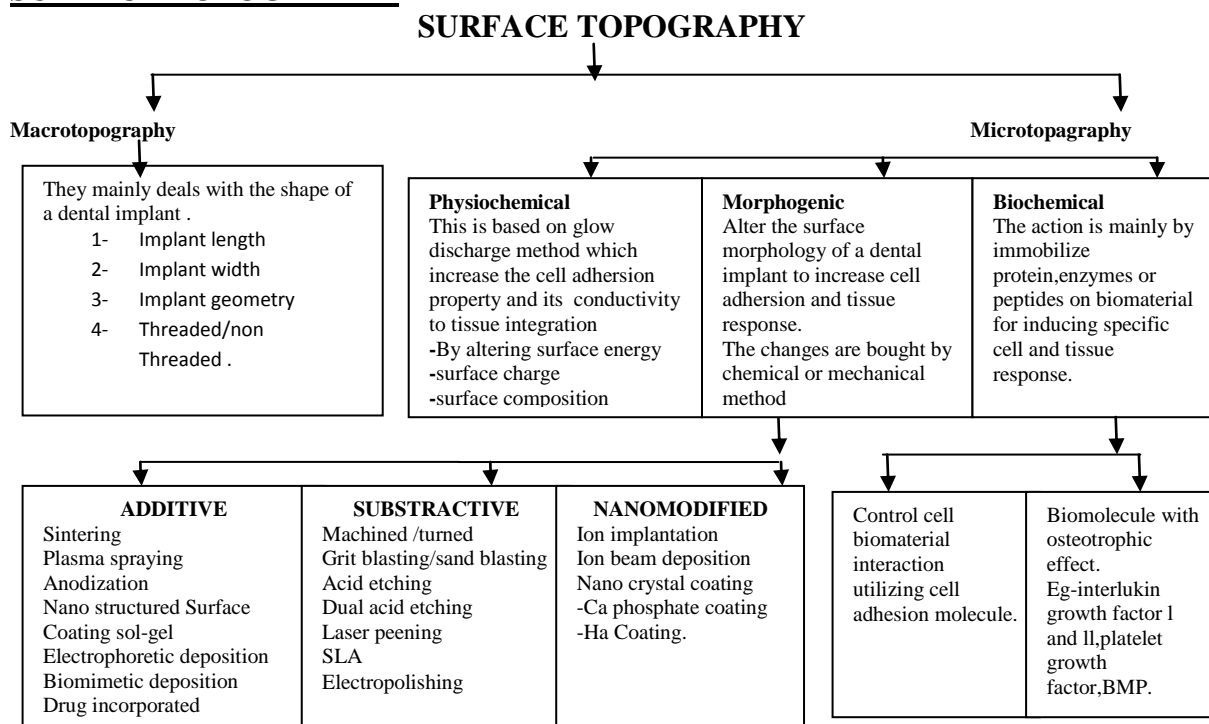
Dental implants are the promising treatment option now available in dentistry to replace a missing tooth. The success and failure of an implant depend up on criteria like local factor, biological factors, factors influenced by clinician and implant related factors. Implant design and surface condition have a great influence on the Osseointegration. Researchers are going on to find out the best way to improve surface condition of an implant. This article reviews the literature of various current innovations on the implant surface treatments.

**Keywords:** implant surface treatment; implant design, sandblasting, plasma spraying.

## INTRODUCTION

In present scenario dental implants are one of the most advanced treatment option in rehabilitation of partially or completely edentulous patients. Dental implants have benefits over the conventional treatment modalities like preservation of bone, preservation of adjacent tooth, esthetics, durability etc. Titanium implants have the magical ability to anchor with bone ie osseointegration. The long term success rate of an implant is influenced by implant surface and implant design. So we can enhance the osseointegration by changing surface topography of an implant.

## SURFACE TOPOGRAPHY



## **SUBTRACTIVE METHOD**

### **Machined surface**

This was initially used technique to modify implant surface. Implant will only submitted to decontamination process after the turning process. This surface is also called machined or smooth implant. As morphology of implant play a vital role in osseointegration. It is necessary to modify the surface by additive or subtractive method.

### **Grit blasting or sandblasting**

This is the process by which an abrasive media is accelerated through a blasting nozzle by means of compressed air. This process will make surface irregularity. Factors effecting irregularity are blasting pressure, time, distance from blasting nozzle etc .Roughening of titanium surface consist blasting the implants with hard ceramic particles. Other materials which are used for sandblasting are Titanium oxide, alumina and calcium phosphate. This procedure is done with aim of increasing the surface irregularity of implant. But some time blasting procedure can leave residual particle on surface of implant and this could modify the bone healing process.

### **Acid etching**

This procedure is performed using bath of HCL, H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> in different combination. The surface of dental implant can be roughened by etching the surface with strong acids like HCL, H<sub>2</sub>SO<sub>4</sub>, HNO<sub>3</sub> above 100°C .this process will create micro pits of 0.5-2mm. dual acid etching technique found to be more efficient to achieve desired results.

### **Dual acid etching**

This technique is used to increase the submicron topography these by increasing the biological property of dental implants. This is done by immersing the titanium implant in a mixture of HCL, H<sub>2</sub>SO<sub>4</sub> and heat above 100°C. Advantages of this technique is increase osteoconductive activity.

### **Laser peening**

It is a newly formed technology in which we can perform a contamination free

peening method. Process involved use of high intensity nano second pulses of laser beam (3-5 width) striking a protective layer on the metallic surface, melting the surface layer locally. As this process is contact less the chances of thermal, mechanical deformation of substrate is low.

### **SLA (Sand blasted and acid etched)**

The surface modification can be made by combination of sandblasting and acid etching. Blasting is done with various particles like Al<sub>2</sub>O<sub>3</sub> and TiO<sub>2</sub>, which is followed by etching with HCl and H<sub>2</sub>SO<sub>4</sub>. This will create a micro and macro structure modification. It has got more Osseo conductive properties and higher ability to induce cell proliferation.

### **Electro polishing**

This Technique is also known as electrochemical polishing, anodic polishing or electrolytic polishing. This method removes material from a metallic work piece, which will remove the surface roughness by eliminating peaks and valleys. So this technique is used for polishing and passivation of the metallic surface. Electrolyte used for this purpose is often concentrated acid solution which has high viscosity, eg- sulphuric acid and phosphoric acid.

## **ADDITIVE METHODS**

### **Sintering**

Direct metal lasers sintering (DMLS) is a laser-based AM technique, in which an object is built layer by layer using powdered metals, radiant heaters, and a computer-controlled laser.

DMLS technology can be used to fabricate implant, with property which is compatible to the bone.

### **Plasma spraying**

This is the process of spraying molten metal on the titanium base which results in surface irregularity like valley, pores. The layer formed will be homogenous, smooth and rigid. The growth of bone to this irregularity will create a mechanical interlock and surface irregularity will increase surface area which

aid in initial fixation of implant, especially in soft bone.

Titanium plasma spraying is done by heating titanium to plasma form and spray this plasma on implant surface, this will improve the micro retention.

HA Coating, Hydroxyapatite is a material that may form direct and strong binding between bone and implant. This is done by heating hydroxyapatite with plasma flame at temp 15000-20000K, this will be forced on to the implant surface in an inert environment. Thickness of the coating formed is 50-200 $\mu$ m, roughness is 7-24 $\mu$ m. Coating with hydroxyapatite will increase surface area. The bone implant interface revealed to be better formed with this coating.

#### **Anodization**

It is the process by which oxide films are deposited on Ti implant surface by means of an electro chemical reaction. In this process, Ti surface to be oxidized play as anode in an electro chemical cell with diluted solution of acids acting as electrolyte. Anodized surface result in strong reinforcement of implant to bone.

#### **Nano structured surface**

Produced by galvanostatic anodization of titanium in strong acids (H<sub>2</sub>SO<sub>4</sub>, H<sub>3</sub>PO<sub>4</sub>, HNO<sub>3</sub>, HF) at high density (200 A/m<sup>2</sup>) or potential (100v)

#### **Sol gel coating implants**

This method applies thin homogenous chemical distribution on the implant surface. It has got many advantages like increase toughness, early bone formation and it will improve osseointegration.

#### **Electrophoretic deposition**

This is the process which colloidal particle, such as nano precipitates which are suspended in a liquid medium migrate under the influence of an electric field and is deposited on to a counter charged electrode. Coating is simply formed by pressure exerted by potential difference between electrodes.

#### **Biomimetic precipitation**

A surface treatment method in which implant surface is coated with a biomimetic

agent. A biomimetic agent is an "agent /material able to replicate or imitate a body structure (anatomy) and function (physiology) (glossary of implant dentistry) It has been shown that such biomimetic coatings are more soluble in physiological fluids and resorbable by osteoclastic cells such as dentin materials.

### **BIOMIMETIC AGENTS USED**

Bioceramics

- Hydroxyapatite(HA)
- Calcium phosphate phases.

Bioactive proteins

- Bonemorphogenic proteins (BMP)
- Type1collagen
- RGDpeptidesequence.

Ions

- Fluoride.

Polymers

- Chitosan

#### **Drug incorporated**

Surface treatment of implant with antibacterial coating serves the possible way to prevent surgical site from infection. Gentamicin can be used along with HA coating. Tetracycline -HCl treatment is also an efficient method for decontamination and detoxification of implant surface.

### **NEED FOR IMPLANT SURFACE TREATMENT**

- To increase the surface area
- To bring better bonding
- To increase surface roughness
- To make the make them more passive
- To remove the surface contamination

### **CONCLUSION**

The surface treatment in the field of implantology has shown tremendous increase in the success rate of implant. The major challenge is mostly this technique are performed in condition different from natural condition. So the tissue reaction towards this surface treatment should be fully understood. The success of an implant is depending up on the use of various modifications in accordance with the situation to obtain maximum benefit for the patient.

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