International Journal of Healthcare Sciences ISSN 2348-5728 (Online)
Vol. 3, Issue 1, pp: (382-384), Month: April 2015 - September 2015, Available at: www.researchpublish.com

Surface Modifications of Dental Implants - A Brushup

[1]Dr. S. PARTHIBAN, [2]R. KADHIRESAN, [3]SHIVA SHANHARI T.,
[4]DANNY MATHEW, [5]NIZAR AHMED, [6]VIKRAM BVDDHANESAN

[1]Senior Lecturer, [1, 2, 3,4,5,6] Thai Moogambigai Dental College, Golden George Nagar, Mogappair East, Chennai

Abstract: **Dental implants are present day tool in replacement of missing tooth, success of implant is based on its Osseo integration to its alveolar bone, various factors influence this Osseo integration among one is surface modifications made in the implant. In this review we will brush up the current trends in surface modification and their role in Osseo integration.**

Keywords: **Dental implants, Surface modification, Osseo integration.**

1. INTRODUCTION

Titanium dental implants have come of age, especially in the last decade or so with regard to its biomechanical designs and alterations in surface properties to increase Osseo integration potential .titanium has advantageous bulk properties such as low modulus of elasticity ,light weight, poor heat conduction and high strength to weight ratio[1],

To improve the Osseo integration potential, many attempts have been made to modify the structure, composition and chemistry of titanium surface. Various physical and chemical treatments of the titanium surface have been proposed to obtain the most biocompatible implant surface[2.]

Thus the focus of this article is on implant surfaces, the methods used for their preparation and the effectiveness of different surface designs in promoting and maintaining Osseo integration as found in the literature.

2. GRIT BLASTING, ACIDETCHING AND MICROARC OXIDATION

To improve the Osseo integration potential of machined, threaded implants the potential bone interface area is increased by grit blasting and acid etching or microarc oxidation[3].

Grit blasting results in an irregular surface with macro and microscopic surface features being related to the size and hardness of the blasting medium and other factors like pressure, angle and distance of the implant surface from the blasting source .aluminum oxide, titanium oxide and zirconium oxide particles have been used for blasting.

Acid etching is carried out with 1%hydroflouric acid and even hydrochloric and sulfuric acid results indicated that acid etching after grit blasting removes the blasting particles and other impurities that might inadverintly adhere to the surface.it also results in the formation of small micro sized dimples over the entire surface .The average roughness of grit blaster and acid etched (SLA) surfaces was about 2.10 microns

Cytotoxicity tests showed that SLA implants had non cytotoxic cellular effects and appear to be biocompatible .scanning electron microscopic examinations showed that the surface roughness produced by sand-blasting and acid etching could affect cell adhesion mechanisms. Osteoblasts like cells adhering to SLA surfaces showed an irregular morphology with many pseudopoda. These morphologic irregularities could improve initial cell anchorage.[4]

The other beneficial aspect of acid treatment is in increasing surface hydrophobicity there by decreasing the rate of bacterial colonization of surfaces and allowing connective tissue cells develop matrix at the coronal implant region. Micro

arc oxidation (MAO) following grit blasting by zirconium particle has also been tried to impant surface qualities of implants. The blasted implants were cleaned ultrasonically in acetone, methanol and deionized water.[5] MAO is carried out in an aqueous electrolyte, by applying pulsed DC field to the specimen. The surface of the blasted and micro oxidized implant has similar surface features to the only blasted surface but since it has gone through micro arc oxidizing ,very small pores can be found. The porous surface profiles in the Nano meter range play an important role in the absorption of proteins, adhesion of osteoblastic cells and thus the rate his case is of osseointegration.the average roughness in this case is 0.182µm whereas for smooth machined implant it is 0.063µm.

3. SURFACE MODIFICATION BY PLASMA SPRAYING

Plasma sprayed implants are formed by introducing powders with particles of 100-300µm size through the peripheral region of hot plasma flame whereby they are partially or fully melted and then sprayed at high velocity as molten spats on a relatively cool metal surface and they rapidly solidify on the preroughened surface .repeated deposition results in the buildup of desired thickness of about 30-50 microns.[6]

Such plasma spraying are carried out by either Ti or hydroxyapatite powders. The later consists mainly of tricalcium phosphate, amorphous calcium phosphate and calcium oxide .Ti powder results in chemical bonding of coating –substrate structure while HA is almost entirely dependent on mechanical interlocking. [7]While increased osteo conductivity has been observed in HA plasma sprayed implants there are other problems associated with the same. Because of difference of coefficient of thermal expansion between various HA and titanium surfaces, cracking of the former will occur during cooling after the deposition process as a consequence disturbed coating surface might lead to increased mechanical abrasion due to high tension stresses[8]

4. BIOCHEMICAL MODIFICATION OF TITANIUM IMPLANT SURFACES

Biochemical (biomimetic) surface modification is carried out by immobilizing small peptides found in the extracellular proteins to promote cell adhesion .the most important peptide sequence is RGD(ARGININE-GLYCINE-ASPERTIC ACID)derived from fibro nectin[9] .In general an increase in cell numbers and more spread cells were observed in bioactive substrates (containing RGD)compared to bio inactive surface .more fibroblasts were present on smooth than on rough surface[10]. More fibroblasts were present on smooth than on rough surfaces whereas opposite tendency was observed for osteoblasts.

5. SINTERED POROUS SURFACE IMPLANTS

Sintering of titanium alloy powder is performed to form a porous surfaced structure by solid state diffusion process in which metal particles achieve metallurgical bonding.[11] Through a judicious choice of sintering parameters (temperature ,time and atmospheric pressure)structures can be formed with an interconnected porous network of desired size and volume with pores uniformly distributed throughout the structure (pore size 50-150µm)in this way surface area of an implant can be increased by 2.5-3 times and extremely short implants (5mm sized implants can be placed in areas of shorter bone height /SPS surfaces have been shown to be osteoconductive .it has been shown in rabbits models That SPS surfaces have significantly faster Osseo integration compared to plasma sprayed implants.[12]

6. IMPLANT-SOFT CONNECTIVE TISSUE INTERFACE

For long term success of implants, equally important along with Osseo integration is the establishment and maintenance of soft connective tissue –implant interface at the coronal implant region. A smooth machined ,polished implant surface with an average roughness of 0.1µm to 0.03µm and having 1-2 mm length is preferred this is because fibroblasts and in some cases epithelial cells show preference for smoother surface whereas osteoblasts exhibits a more osteoblastic phenotype on rough titanium surface .it has been seen that significant amount of bone loss occurs collarless implants which effects long term prognosis[13]

Implant surface preparation by machining, grit blasting and plasma spraying are often referred to as subtractive process as they involve removal of material from the implant surface whereas plasma spraying and sintering can be described as additive process as material is added to the substrate.[14]

In compromised implantation sites where short implant lengths must be used or in low bone density sites where rapid Osseo integration is the need of the hour: the use of various surface modified implants as described earlier will provide greater reliability in these challenging situations.

REFERENCES

[1] Schuler,owen etal ;Biomimetic modification of titanium dental implant model surfaces using RGD SP –peptide sequence: A cell morphology study .biomaterials 27(2006)4003-4015.

[2] Wennerberg A, Albrektsson T. On implant surfaces: A review of the current knowledge and opinions. Int J Oral Maxillofac Implants 2010; 25(1):63-74.

[3] Wennerberg A, Ektessabi A, Albrektsson T, Johansson C, Andersson B. A 1-year follow up of implants of differing surface roughnesS which were placed in a rabbit bone. Int J Oral maxillofac Implants 1997; 12(4):486-94

[4] Orsini G, Assenza B, Scarano A, Piatteli M, Piatteli A. Surface analysis of machined versus sand blasted and acid etched Ti implants.Int J Oral Maxillofac Implants 2000; 15(6):779-84.

[5] Kummer FJ, Ricci JL, Bluementhal NC. RF plasma treatment of the metallic implant surfaces. J Applied Biomater 1992; 3:39-44.

[6] Savarino L, Cenni E, Stea S, Donati ME, Paganetto G, Moroni A, et al. X-ray diffraction of newly formed bone which was close to the alumina or the hydroxyapatite-coated femoral stem. Biomaterials 1993; 14: 900-05.

[7] Blumenthal NC, Cosma V. Inhibition of apatite formation by the titanium and the vanadium ions. J Biomed Mater Res Appl Biomater 1989; 23:13-22.

[8] Jimbo R, Sawase T, Baba K, Kurogi T, Shibata Y, Atsuta M. Enhanced initial cell responses to chemically modified anodized titanium. Clin Implant Dent Relat Res 2008; 10:55-61.

[9] Occuzzo M, Wilson Jr, Thomas G. A prospective study of the 3 weeks loading of chemically modified titanium implants in the maxillary molar region: 1-year results. Int J oral Maxillofac Implants 2009; 24(1):65-72.

[10] Song WH, Jun YK, Han Y, Hong SH. Biomimetic apatite coatings on micro-arc oxidized titania. Biomaterials 2004; 25:3341-49.

[11] Woodman JL, Jacobs JJ, Galante JO, Urban R. Metal ion release from titanium-based prosthetic segmental replacements of the long bones in baboons: A long term study. J Orthop Res 1984; 1:421-30.

[12] Hallgren C, Reimers H, Chakarov D, Gold J, Wennerberg A. An in vivo study of the bone response to implants which were topographically modified by laser micromachining. Biomaterials 2003; 24:701-10.

[13] Gaggl A, Shultes G, Muller WD, Karcher H. Scanning electron microscopical analysis of laser treated titanium implant surfaces-A comparative study. Biomaterials 2000; 21:1067-73.

[14] Sul YT, Johansson C, Albrektsson T. Which surface properties enhance the bone response to implants? A comparison of the oxidized magnesium, TiUnite and the Osseotite implant surfaces. Int JProsthodont 2006; 19:319-28.