

Characterization of the Roughness of the AVINENT Dental Implant Surface

PURPOSE

Observation of AVINENT implants whose surface is achieved from combining a *shot-blasting* process followed by an electrochemical treatment process. The *shot-blasting* (particle impact) process provides the surface of the implant with optimum structural roughness. Then the electrochemical process (anodizing) modifies the surface micro-topography by causing porosity in the titanium oxide while also enabling the incorporation of chemical elements (Ca and P) that provide the final surface with some fully biomimetic properties.

MATERIALS AND METHODS

a. Specimen Preparation

Specimens were prepared as appropriate for the AVINENT surface treatment and they were observed with an electronic scanning microscope (fig. 1).



Figure 1.

Document prepared by the **scientific committee of AVINENT Implant System S.L.** ⁽¹⁾ with the collaboration of **CREB** (Centre de Recerca en Enginyeria Biomèdica) ⁽²⁾ and the **CTM** (Centre Tecnològic) ⁽³⁾. Both these centers belong to the **UPC** (Universitat Politècnica de Catalunya).

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b. Measuring Roughness

The roughness of each of the specimens was determined by using a WYCO NT 1100 interferometric microscope from Veeco providing a vertical resolution of <1 nm and a horizontal resolution of 400 nm, which enables three-dimensional images of specimen surfaces to be obtained. These interferometric techniques measure the light interference pattern coming from a reference plane (typically a mirror) and the light reflected on the surface that is intended to be studied. In this study the technique that was used was VSI (Vertical Scanning Interferometry) that uses white light for detecting changes of intensity on stripes and determining height differences in this manner.

Four measurements were performed for each of the surfaces studied. The main parameters studied were:

Ra (arithmetic average of deviations in the profile): This is the arithmetic average of the absolute value of the distances from the midline to profile R within the length of specimen L. This midline is a reference line for calculating the different parameters, which is determined by the least square method with respect to profile R for each specimen length. Ra is calculated in microns and is the most general and most commonly used parameter for describing roughness. (fig. 2).

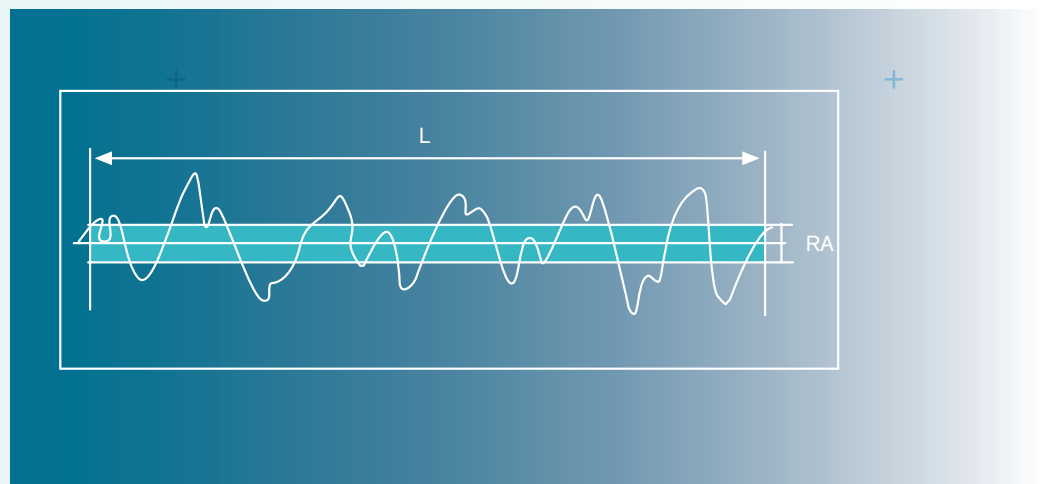


Figure 2. Graphic representation of parameter Ra.

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Rq (arithmetic average of deviations in the profile): This is the average value of the square root of the deviations in the profile with respect to the midline within the length of specimen L. This parameter is more sensitive to extreme values than Ra due to the square root operation. Rq is statistically significant because it is the standard deviation for profile height distribution.

Rt (total peak-valley height): This is the difference between the height of the highest peak and the height of the deepest valley. It is expressed in microns.

Ratio between surfaces: This is the ratio between the value of the actual area of a surface and its nominal or microscopic area.

Sm: average distance between peaks and valleys.

RESULTS

Shown below are the images obtained from the electronic microscope of the *shot blasting* phase with optimum structural roughness, and of the final phase of electrochemical treatment where a large increase in porosity may be observed in the titanium oxide.

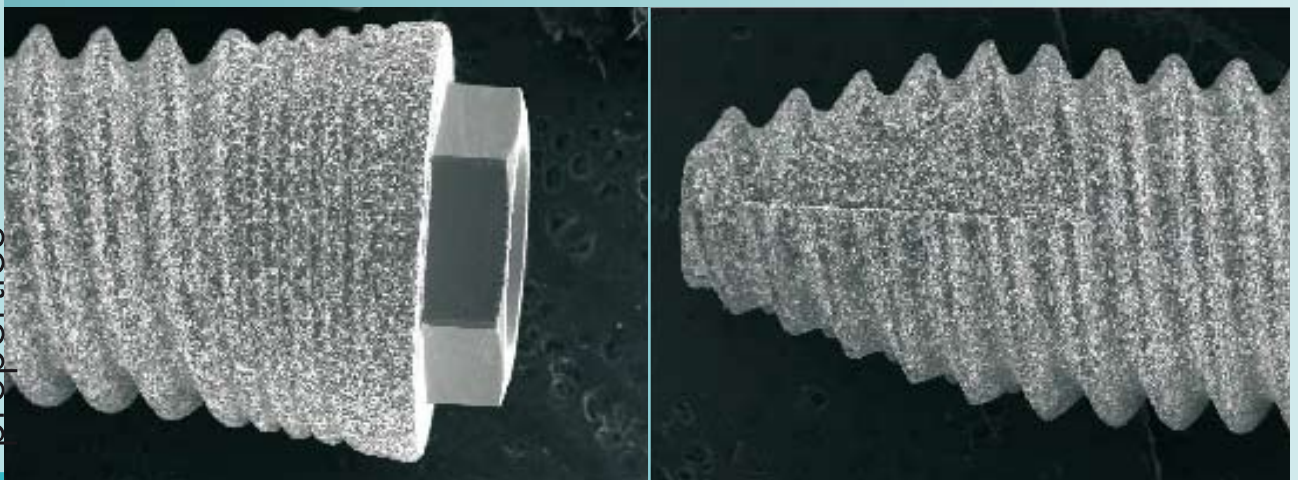


Figure 3. AVINENT implant. *Shot blasting* phase.

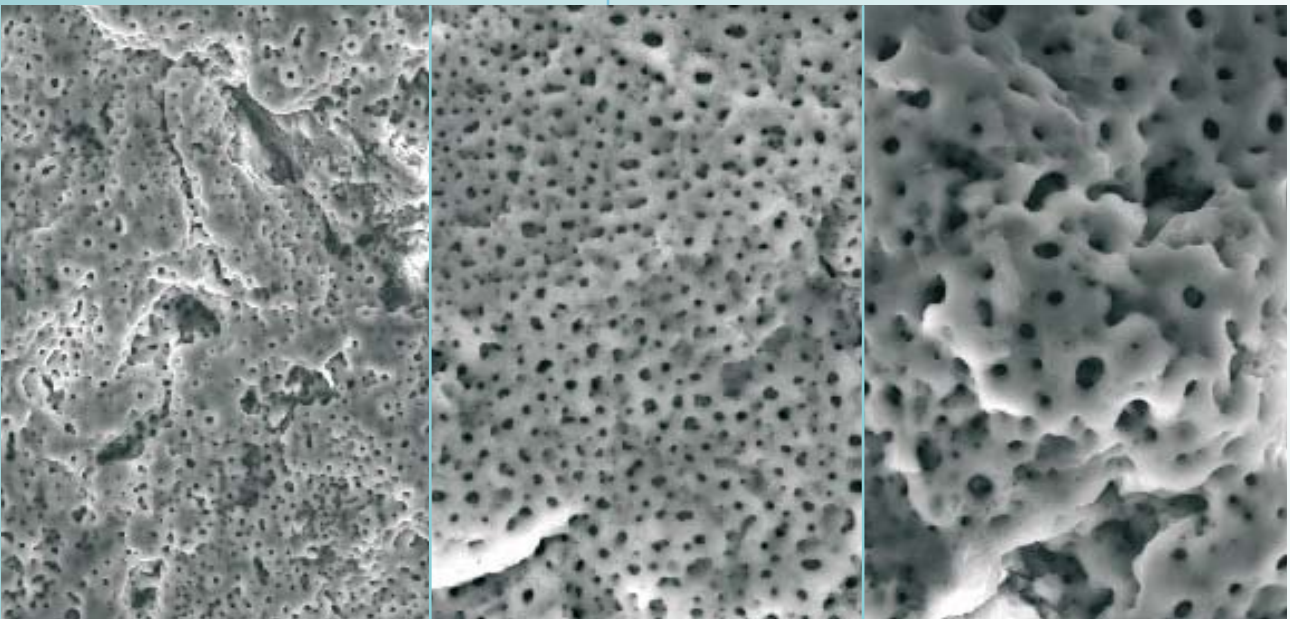


Figure 4. AVINENT implant. Electrochemical treatment phase.

CONCLUSIONS

AVINENT surface treatment considerably increases the total area of the implant by 76%. This fact improves the stability of the dental implant because there is greater area of contact between implant and bone, which thus encourages good osseointegration.

