Abstract

Clinical success of dental implants made of commercially pure titanium (c.p. Ti) is obtained when osseointegration is achieved, i.e., when the surface of the implant is structurally and functionally joined to the newly-formed bone. The improvement of the short- and long-term osseointegration depends on a series of factors. Amongst them, the quality of the implants surface (physico-chemical and topographical) is one of the most important. In fact, the entire biological and mechanical interaction between the implant and the surrounding tissues takes place at their interface.

In this work, different treatments on the surface of dental implants are developed and studied in order to obtain dental implants with a better short- and long-term osseointegration.

In the first part, rough surfaces are obtained by means of a shot-blasting treatment.

The roughness of the shot-blasted c.p.-Ti surfaces do not only depend on the size of the abrasive particles used (125 – 300 μm; 425 – 600 μm; 1000 – 1400 μm), but also on their chemical composition (Al_2O_3, SiC, TiO_2 y ZrO_2) and shape. The roughness must be quantified by means of at least two parameters, one vertical parameter (R_a), and one horizontal parameter (P_c). Moreover, some particles remain attached to the metal surface after the shot blasting and cleaning treatments, whatever the chemical composition of the particles used. Taking into consideration these conclusions, surface properties of shot-blasted c.p. Ti has been optimized because the adhesion and differentiation of osteoblasts depends on the roughness obtained and the composition of the abrasive particles used. Additionally, the electrochemical behaviour of the shot-blasted surfaces is appropriate for their use as dental implants. This occurs despite the fact that the changes in roughness and in residual compressive stresses induced on the c.p. Ti surface by the shot blasting influence its electrochemical behaviour.

In the second part, rough and bioactive surfaces are obtained by means of a two-step treatment: firstly, the implant is shot blasted (with the treatment conditions optimized in the first part); and secondly, a thermochemical treatment is applied on the titanium surface. The thermochemical treatment consists of a NaOH-etching, which induces the formation of a sodium-titanate hidrogel on the surface of the c.p. Ti. This gel is dehydrated and densified by means of a thermal treatment at 600 ^{o}C in these conditions, the c.p. Ti is bioactive.

The c.p. Ti surfaces that are shot blasted with Al_2O_3 and thermochemically treated demonstrate their potential bioactivity because an apatite layer grows on them *in vitro*. The bioactivity is further confirmed because the apatite layer also grows *in vivo*. However, the SiC-particles which remain on the metal surfaces inhibit this bioactive behaviour. The rough and bioactive surfaces are studied, *in vitro* and *in vivo*, comparing them with others that are not rough and/or bioinert. The differentiation of the osteoblasts *in vitro* as well as the short- and mid-term ossointegration are favoured by the synergistic combination of the metal roughness and metal bioactivity. Consequently, the rough and bioactive dental implants are preferential candidates for use in immediate-loading clinical procedures.