**Effect of surface roughness on adhesion of *Streptococcus oralis* to titanium surfaces**

**M Dorkhan, L Chávez de Paz, G Svensäter and JR Davies**

Department of Oral Biology, Faculty of Odontology, Malmö University, SE-205 06 Malmö, Sweden

**Introduction:** Modern dental titanium implants are often moderately rough, with an average surface roughness (Sa) of 1-1.5 μm (Wennerberg *et al.* 2009) which is designed to encourage rapid osseointegration through increased bone-to-implant contact and stimulation of osteoblast activity. When such surfaces become exposed in the oral cavity, they are immediately covered with a pellicle derived from saliva and/or serum which changes the surface properties and provides attachment sites for oral bacteria. Following the establishment of microbial biofilms, a rough surface can hinder the removal of bacteria by mechanical debridement (Amarante *et al.* 2008). The presence of a microbial biofilm on the surface may then result in the development of a peri-implant infection leading to tissue destruction and thus, although studies have shown improved initial osseo-integration, the long-term prognosis for such moderately rough implants remains unclear.

**Objective:** To investigate how surface roughness as well as the presence of a saliva- or serum-derived pellicle affects adherence of clinical strains of *S. oralis* (isolated from dental plaque and peri-implant infections) to titanium surfaces used in dental implants.

**Conclusions:** Our data demonstrate that surface roughness as well as the nature of the conditioning protein pellicle play an important part in determining the level of adherence of oral streptococci to titanium dental implant surfaces. Different strains of *S. oralis* exhibit different levels of adherence to the surface and the adherent protein pellicles. The presence of a saliva-derived pellicle promoted bacterial adhesion to titanium surfaces while serum-derived pellicles had little or no effect.

**Methods:**

- **Surface preparation:**
  - Titanium plates with average surface roughness (Sa) of 0.1 μm (turned) and 1.4 μm (blasted) were used uncoated or coated with human saliva or serum.

- **Biofilm formation:**
  - Mid-exponential growth phase cultures (OD₆₀₀ = 0.5) of three fresh isolates of *Streptococcus oralis* (LA11, 89C and 192B) were passed over the surfaces in the flow-cell system for 2 hours. The surfaces were then rinsed for an additional hour with Todd Hewitt medium.

- **Image acquisition and analysis:**
  - Adhered bacteria were visualized using confocal laser scanning microscopy (CLSM), after staining with the Live/Dead BacLight stain. Experiments were carried out three times using independent bacterial cultures.

**Results:**

- **CLSM images demonstrated markedly greater levels of adherence for all strains of *S. oralis* on moderately rough (blasted) surfaces than that on smooth (turned) surfaces.
- **Image analysis confirmed that the level of adherence for all strains on blasted surfaces was significantly greater than that on turned ones (p<0.05) even after compensation for the greater developed surface area of the blasted surface.
- **Strains LA11 and 89C adhered at much higher levels to both turned and blasted surfaces than strain 192B.
- **For strains LA11 and 89C, but not strain 192B, there was a significant difference between adherence in the presence of a saliva- or a serum-derived pellicle (p<0.0001) (images above show the results for the blasted surfaces).
- **On both blasted and turned surfaces, a saliva-derived pellicle significantly increased adherence compared to the corresponding uncoated surface whereas the serum-derived pellicle had little effect (graphs above illustrate results for blasted surfaces with dotted lines representing level of bacterial adherence on uncoated ones).
- **Thus, these results confirmed that the three strains of *S. oralis* differ in their levels of adherence. For two strains, a saliva-derived pellicle enhanced adherence whereas serum did not.**

**References:**