Early development and documentation of OsseoSpeed™

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Background

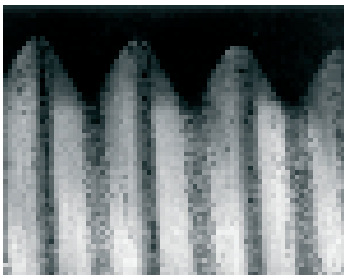
The demand and request for reducing the time between placement and loading of dental implants, and for the use of implants in sub-optimal bone require implants with defined and documented positive biomechanical and biological performance. Living tissue has a high potential for regeneration of bone. Optimizing the conditions for the adherent cells after implant placement will improve activity and promote better bone-to-implant integration and implant retention in bone. By "teaming" with the tissue and utilizing its natural growing power (regeneration potential) there is no need to introduce artificial growth substances for stimulation of bone regeneration.

The OsseoSpeed™ surface has been developed as a result of a large-scale research program. The TiO_2-blasted surface has a fluoride-modified titanium dioxide layer. Through a number of in vitro and in vivo studies this new surface has demonstrated superior qualities compared to other rough implant surfaces. This means that the implants can carry loads at an earlier point in time and can be placed with improved predictability in sub-optimal bone. This is done without compromising the historically known criteria for implant success. Improved bone-to-implant reactions can be reflected through histology and retention between implants and bone.

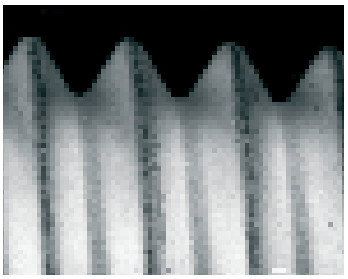
High adsorption of calcium phosphate

In two studies TiO_2-blasted implants (control) and TiO_2-blasted and fluoride modified implants (test) were exposed to solutions containing calcium and phosphate and their reactions with calcium phosphate were analyzed. The fluoride modified test implants attracted calcium phosphate to the surface and this could be observed by the formation of a number of calcium phosphate containing crystals on the surfaces. In the other study the solution

contained radioactive-labeled phosphate and the degree of radioactivity of the implants after the test was used as a measure of the adsorption of calcium phosphate to the implant surface. The implants with fluoride modified surfaces had significantly higher radioactivity than the control implants, which indicated higher adsorption of calcium phosphate to this surface. The capability to adsorb calcium and phosphate promotes the bone formation and bone bonding processes.



Calcium phosphate (CaP) precipitates on the fluoride modified test surface demonstrating affinity for CaP.



No calcium phosphate reacted with the control surface.

New bone formed on the fluoride modified implant surface in the bone marrow region of rabbit tibia.

Superior bone response and attraction to OsseoSpeed™ surface

Fluoride modified fixtures have been implanted into bone in a number of animal studies for investigating bone healing. Histological analysis of the bone-to-implant interface has illustrated the superior bone response and attachment to the OsseoSpeed™ implant surface. Significantly higher bone-to-implant contact has been documented as soon as one month after implant placement compared to other rough surfaces. In a study with two months' observation before histology new bone formation was identified on the OsseoSpeed surfaces that were placed in the bone marrow region of rabbit tibia. These implants were covered with new bone from the marginal area to the apical, providing stability to these implants.

In the same study, implant stability was tested by removal torque and the implants with OsseoSpeed surface had significantly higher retention in bone compared to machined or rough surfaced implants. Investigating the implants after the removal torque test revealed that bone was still attached to the surface. This finding showed a very strong bone-to-implant attachment; this was not observed on the control implants.

The same trend, with significantly higher bone-to-implant attachment and more bone-to-implant contact, has been observed in other animal studies documenting bone responses at shorter or longer healing periods.

Conclusion

These studies, which are the basis of the OsseoSpeed documentation, all demonstrate improved bone response, resulting in better integration after shorter or longer healing periods compared to other implant surfaces tested.