16026 POSTER DISPLAY BASIC RESEARCH

Physical Characterization and Osseointegration of 3 implants with distinct materials and surfaces

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Background: Dental implants are manufactured from various Ti grades and Ti alloys; diverse surface treatments are implemented. Subsequently, implants display distinct surface texture characteristics and composition. It has been claimed that 'because of the biphasic nature of the TiAlV alloy, sandblasting and acid-etching is typically not an appropriate treatment for alpha-beta alloys'. This issue needs to be addressed by comparing well physically characterized surfaces to osseointegration data.

Aim/Hypothesis: Aim was to compare in a rabbit model the osseointegration rates of well physically characterized surfaces of 3 distinct implant systems. Investigated implants were made of titanium cp and titanium alloy Gr. 23. Surface treatments were sandblasting-and-acid-etching and anodic oxidation.

Material and Methods: Implants belonged to the following groups: G1, Ti cp Grade 4, sandblasted-and-etched (Straumann, SLA, BL); G2, Ti cp Grade 4, anodic oxidation (NobelBiocare, TiUnite, Replace); G3, Ti Gr. 23 (TiAl6V4 ELI) sandblasted-and-etched (MIS, SLA, V3). Implant dimensions were: G1, Ø3.3x8 mm; G2, Ø3.5x8 mm; G3, Ø3.9x8 mm with a triangular neck and gap of 0.2x3.7 mm. Roughness (Sa) was determined between the threads with an optical profilometer (filter 250mic, area 500x1000 mic). Surface topography and element composition were observed under SEM/EDS (x20-4000). Surface composition was determined by XRD (2 teta : 30-80°), presence and size of Ti hydride needles (TiH-n) was determined on etched metallographic sections, segregation of Al and V at the alloy surface was determined by SIMS, concentration profile was gained using O- and Cs; ions at 500 eV. Implants of each group (n = 8x3) were implanted in the tibia of 6 rabbits for 45 days. Histological sections were prepared and BIC was measured.

Results: Under SEM, all surfaces looked differently- G1 and G3 displayed a macro and micro-texture for bone ingrowth; G3's macrotexture was rounder. G2 showed Ø 3-12mic canyon-like structures for bone ingrowth. Sa roughness of G1 G2 G3 implants was 2.56 1.10 1.89mic. XRD EDS led to distinct surface compositions- on G1, Ti alpha phase and Ti hydride; on G2, Anatase Ti oxide rich in P; on G3, Ti alpha and beta phases. The metallographic sections revealed- on G1, presence of 3-18 mic long TiH needles, TiH needles concentration was higher at the thread level; on G2, a rough porous 3-16 mic thick Ti oxide layer sitting on a lower density base, no TiH-n; on G3, Ti beta phase grains distributed among a Ti alpha phase matrix, no TiH-n. Concentration profile by SIMS on G3's surface showed an increased amount of O and depleted amounts of Al and V. After 45 implantation days, the BICs of the G1 G2 G3 groups were similar- 58.7 ± 1.8% 58.1 ± 1.6% 59 ± 2% (P = 0.94, NS); G3's gap was filled with bone.

Conclusion and Clinical Implications: Surface topography and composition of G1, G2, G3 were all different. Surface treatment of G1 and G2 generated new compounds at the implant surface, TiH on G1 and anatase rich in P on G2. TiH-n were found on G1 only. On G3, Al and V were depleted at the surface. Despite distinct surface characteristics and composition, osseointegration was similar for the 3 implant systems; G3's gap was filled with bone. Sandblasting-and-etching was an appropriate treatment for the TAV alpha-beta alloy implant.