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Titanium hydride and hydrogen concentration in acid-etched commercially pure titanium and titanium alloy implants: a comparative analysis of five implant systems”*

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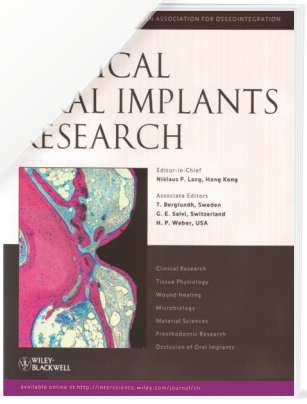

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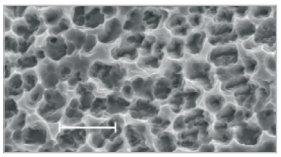
A.



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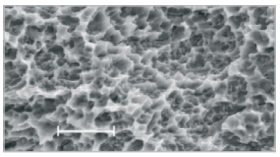

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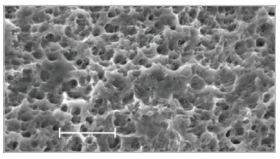

Scanning electron microscopic micrographs of the implant surfaces. (A) Ankylos Cell-Plus implant. Strong etching conditions have carved the commercially pure (cp) Ti surface with pores. Line is 10µm (original magnification x 2000). (B) Straumann SLActive implant. Sandblasting and etching with boiling acids created this complex carved topography. The line is 10µm (original magnification x 2000). (C) MIS BioCom implant. Strong etching conditions dissolved the b-phase as well and carved pores in the alloyed material. At this magnification, the effect of sandblasting is not evidenced on this picture. The line is 10µm (original magnification x 2000).

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ABSTRACT.

Objectives

Acid etching is a popular method to texture the surface of dental implants. During etching, the titanium oxide protective layer is dissolved and small native hydrogen ions diffuse into the unprotected implant surface. They enrich the implant surface with hydrogen and precipitate into titanium hydride (TiH). The aim of this study was to measure the concentration of TiH at the implant surface and the total concentration of Hydrogen at five commercially available implant systems, made of either commercially pure (cp) titanium or titanium alloy.

Materials and methods

X-Ray diffraction (XRD) was conducted on each implant system to determine the compounds present at the implant surface. Following a TiH_2/Ti calibration curve, the concentration of TiH was determined. Concentration of hydrogen in the implants was measured by the inert gas fusion thermal conductivity/infrared detection method.

Results

XRD data showed that TiH was present on all cp titanium implants but not on the alloyed implants. TiH concentration varied between 5% and 37%. Hydrogen concentration varied between 43 and 108 ppm, no difference in uptake was found between the cp titanium and alloyed implants. Low solubility of hydrogen in α-titanium is responsible for precipitation into TiH. Stronger etching conditions led to higher concentration of TiH2-x.

Conclusions

High solubility of hydrogen in the β-phase of the alloy is preventing hydrogen from precipitating into TiH. All implants, even those lacking TiH at the surface, were enriched with hydrogen. In all implants, hydrogen concentration was within the normative limit of 130 ppm.