

Optical Characterisation of Dental Implants Improves Treatment

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Abstract

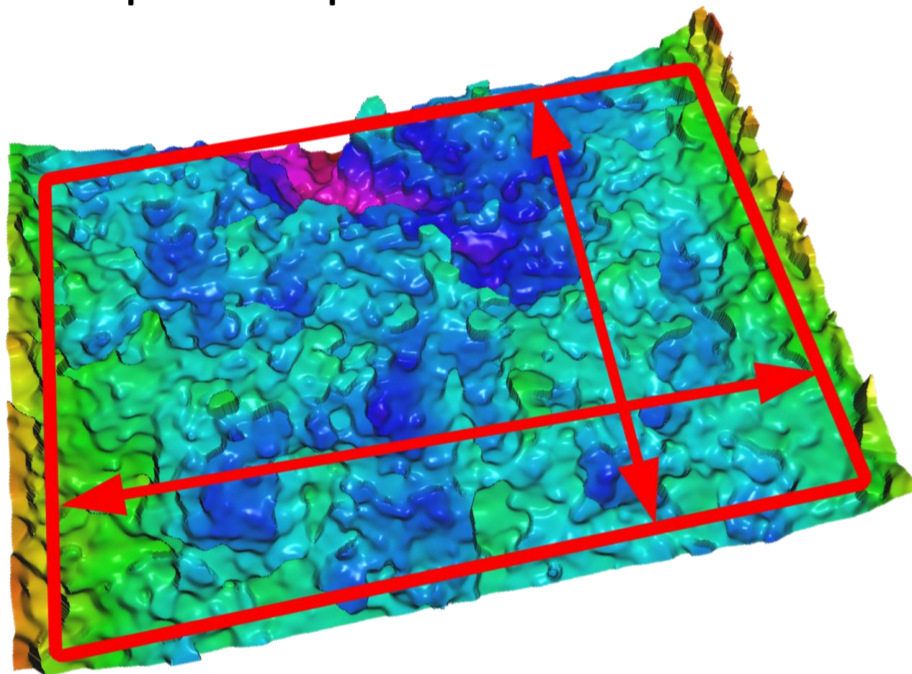
The surface characteristics of a dental implant are crucial as these are the decisive factors for the successful and permanent adhesion with the jaw bone. In order to grow together quickly and sustainably, the surface of the implant has to have the correct characteristics to allow protein to bind to the implant. This requires that every part of the implant that is in contact with the bone needs to be measured and characterised to establish and quantify the optimum surface features. With the knowledge of the optimum characteristics surfaces can be treated or modified to ensure maximum life and reliability. This in turn leads to reduced patient trauma as the implants will become permanent. InfiniteFocus is the optical measurement device used for measuring roughness and complete form of implants.



Results

ROUGHNESS ON THE GROOVE

Good and bad tooth implants have been analyzed in order to evaluate how the roughness at the bottom of the groove stays in correlation to the tooth implant quality. A 3D dataset of the measured groove of a good implant is provided below.



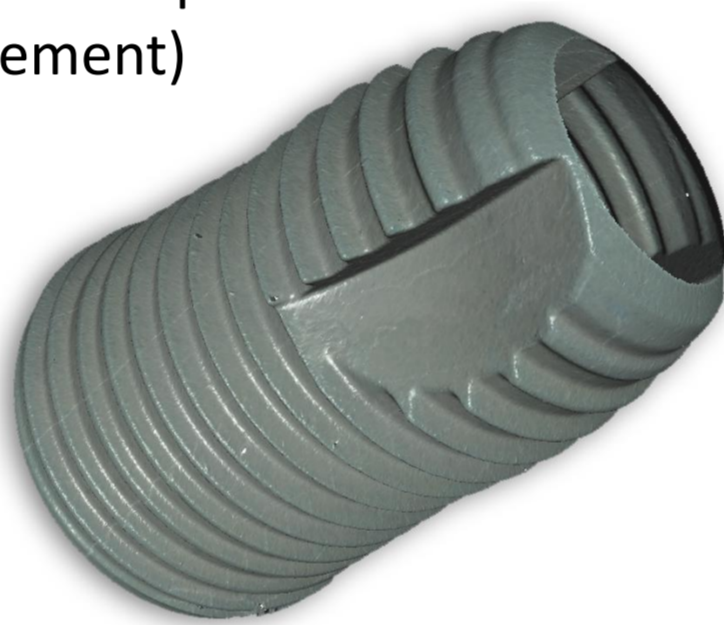
3D dataset of the bottom of the groove of a good tooth implant

In the following table various profile roughness parameters are provided for two measurement areas of both, good and bad parts. The results show that roughness parameters of the good part are about a factor 3 – 10 higher than those of the bad part. Some roughness parameters are well suited to distinguish between the parts (Ra, Rq, Rk...) whereas others are not. Roughness values as specified in ISO 4287.

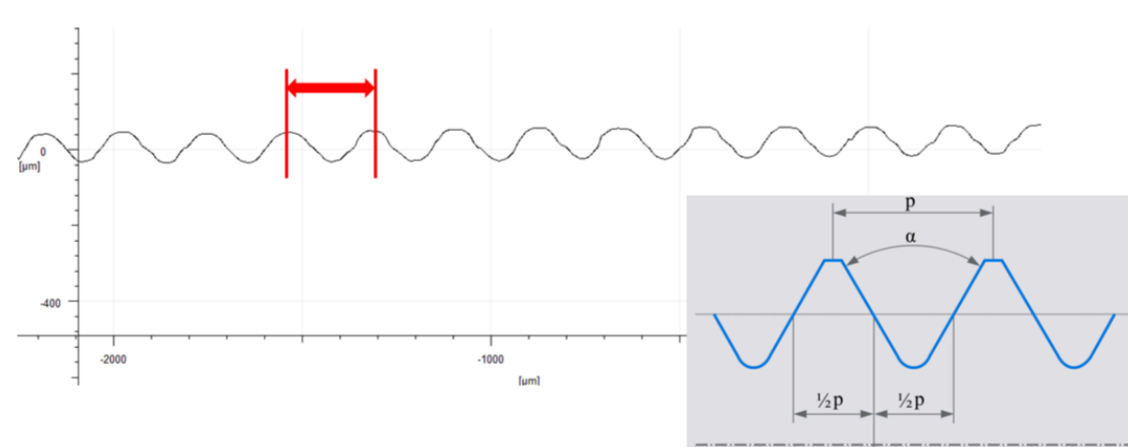
	Good part		Bad part	
	Area 1	Area 2	Area 3	Area 4
Ra (nm)	267.02	413.92	72.878	52.665
Rq (nm)	348.38	496.5	94.789	88.812
Rz (µm)	1.0004	1.468	328.34	244.25
Rku	3.3652	2.2833	3.5448	10.532
Rdq	0.0978	0.1193	0.03775	0.0335
Rk	701.07	1302.4	209.88	102.83
Rpk	565.1	457.09	145.33	204.37

FORM OF THE IMPLANT

The form of a tooth implant has a strong impact on its function. In the following image we provide a full 360° measurement of a tooth implant that has been obtained by the InfiniteFocus system including the Real3DRotationUnit. In order to judge the quality of the measured implants the thread pitch has been evaluated at 10 positions. (See the profile beneath the 3D measurement)



Full 360° dataset of a tooth implant measured by the proposed system



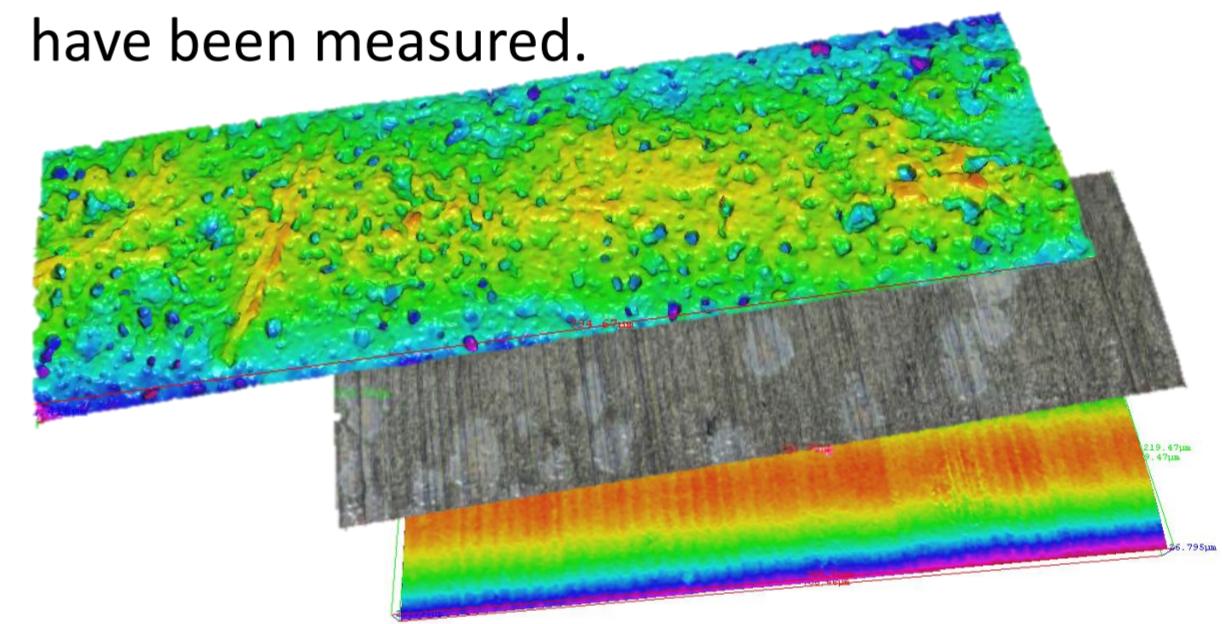
Profile of the thread region with a thread pitch measurement at one exemplary position

In order to judge the quality of the measured implants the thread pitch has been evaluated at 10 positions. This allows verifying the homogeneity of the part on different regions as provided in the following table.

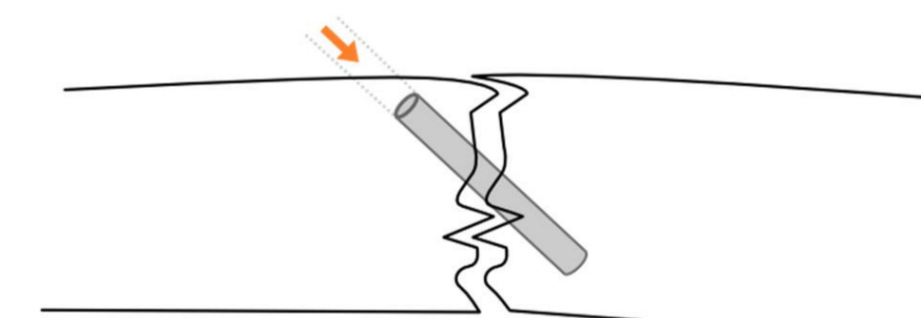
218.11	215.44	223.96	216.29	222.29
220.77	220.29	227.10	216.15	228.07
Mean: 220.85 µm	St. Deviation: 4.51 µm			

OTHER APPLICATIONS

Bioresorbable Bone Implant Measurements
Recent developments now focus on implants that are degradable or bioresorbable in the bone after the healing of the fracture. With InfiniteFocus 3 different materials were measured and compared. Roughness parameters to characterize the material have been measured.



Three different implant materials



Schematic implant visualization

High Resolution Jaw Measurement
Large measurement fields allow measurements of whole jaw replicas. This again allows manufacturing precise copies of the original teeth and correct positioning.

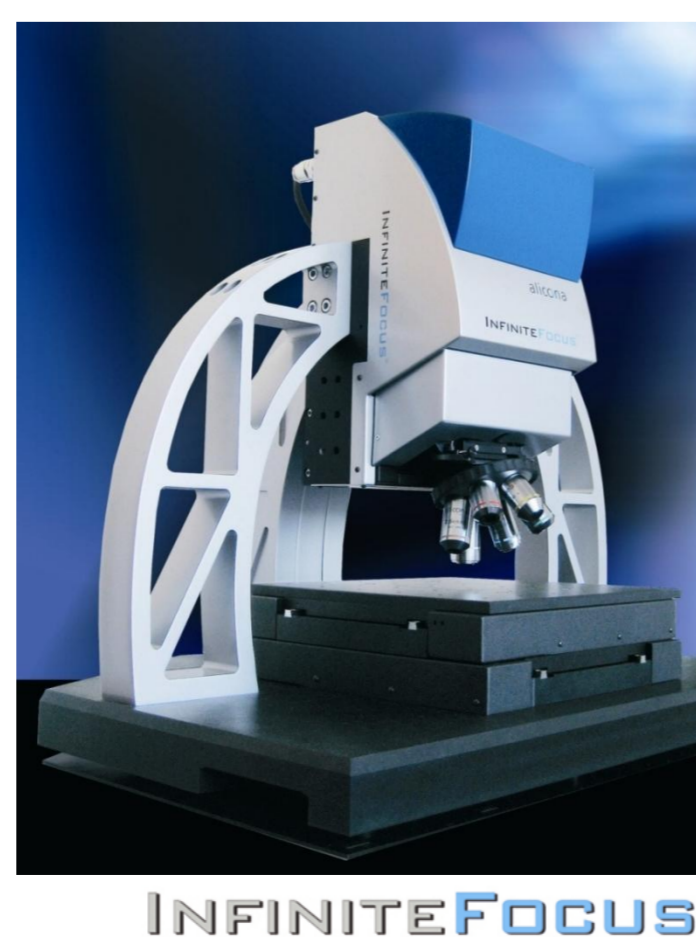


Jaw measurement

Measurement Device

InfiniteFocus

InfiniteFocus is an optical 3D measurement device for quality assurance in the micro- and nano range. It provides all functionalities for dimensional measurements, surface analysis and characterization. Geometries with steep flanks, highly reflective properties and strong roughness are measured with a vertical resolution up to 10nm. The 3D measurements are performed directly on the optical image.



INFINITEFOCUS®

Technologies

FOCUS-VARIATION

The operating principle of InfiniteFocus is Focus-Variation which combines the small depth of focus of an optical system with vertical scanning to provide topographical and color information from the variation of the focus.

Real3D

Real3D allows measurements of parts around 360°. In combination with Focus-Variation geometries of e.g. tooth implants can be fully measured.

