Influence of Surface and Implant Design on Stability of Five Commercial Titanium Implants. A Biomechanical Study in The Rabbit.

Jan Gottlow, DDS, PhD I Lars Sennerby, DDS, PhD

Correspondence: Dr. Jan Gottlow, Dept. Biomaterials, Gothenburg University, PO Box 4l2, SE 405 30 Gothenburg, Sweden. Phone: +46 31 786 2950, Fax: +46 31 786 2941, e-mail: jan.gottlow@telia.com

UNIVERSITY OF GOTHENBURG

Various surface technologies and designs of dental implants representing different geometry are commercially available and clinically used in patients (Figure 1). However, data with regard to bone tissue responses and stability for comparison of their biologic performances are rare.

The aim of the present experimental investigation was to compare implant stability between five commonly used dental implants representing different surface characteristics and geometries.

The study was performed in 40 rabbits. One test implant with a hydrophilic sand-blasted and acid etched surface (SLActive®) and 4 control implants with non-hydrophilic surfaces were evaluated. The implants were inserted in the tibial metaphyses and the distal femoral condyles (Figure 2B). A split leg / random design allowed for comparison of test and control pairs of implants placed at similar positions in the 2 legs. On one side 3 test implant (SLActive®) were placed. On the other side 3 of the 4 control implants (A, B, C and D) were placed and rotated in position (Figure 2A). The implant stability was assessed by removal torque (RTQ) evaluation after 3 and 6 weeks. (A histological evaluation of the bone healing is currently ongoing).

Conclusion

The hydrophilic sand-blasted and acid etched implant showed superior implant stability compared to the implants with non-hydrophilic surfaces as assessed by removal torque evaluation.

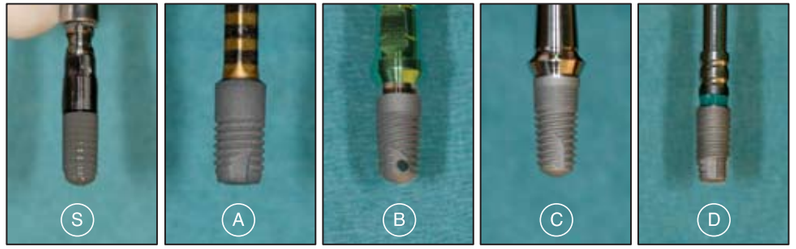

Figure 1 Photographs showing 5 commercially available bone level implants. Straumann® BL RC (S), Astra Osseospeed™ (A), Zimmer Tapered Screw Vent® (B), Implant Direct ScrewPlant™ (C), Osstem GS II Fixture (D).

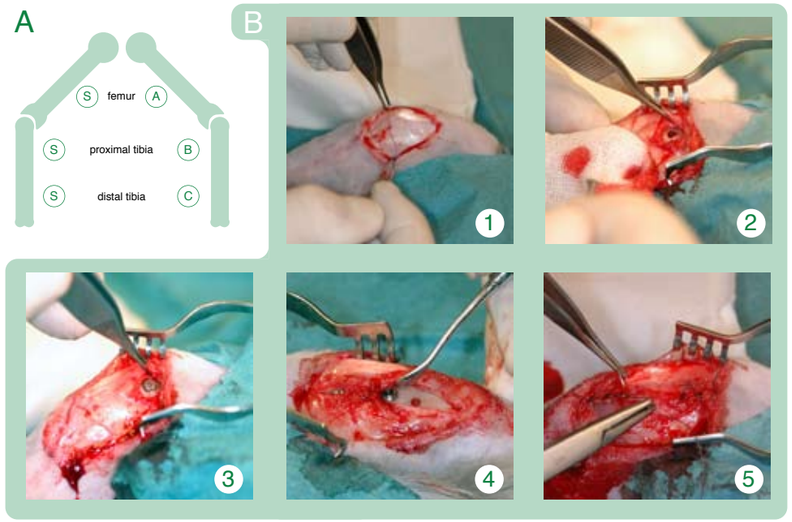

Figure 2A Split leg/random design allowing the comparison of test and control pairs of implants. Test implants (S) were placed in one leg, whereas 3 of 4 control implants (A, B, C and D) were rotated in position and placed in the other leg.

Figure 2B Photographs showing surgical procedures on Swedish loop rabbits.

Table 1 Surface properties of test (S) and control implants (A-D).

		S	A	B	C	D
Dimensions (μCT)	Mean radius	1.91 mm	1.85 mm	1.64 mm	1.59 mm	1.79 mm
	Length (Cylindrical Part)	7.3 mm	7.5 mm	6.9 mm	7.3 mm	8.1 mm
	Surface Area	104.8 mm^2	110.3 mm^2	98.4 mm^2	99.3 mm^2	120.5 mm^2
3D Roughness (CWLM)	Average mean deviation S_a	1.05 μm	0.60 μm	0.54 μm	0.77 μm	0.64 μm
	Max. peak to valley height S_t	6.91 μm	4.21 μm	3.99 μm	5.48 μm	4.32 μm
	Skewness S_{sk}	0.15	-0.05	-0.28	-0.15	-0.13
Hydrophilicity	Dynamic Contact Angle	0°	138°	120°	112°	124°

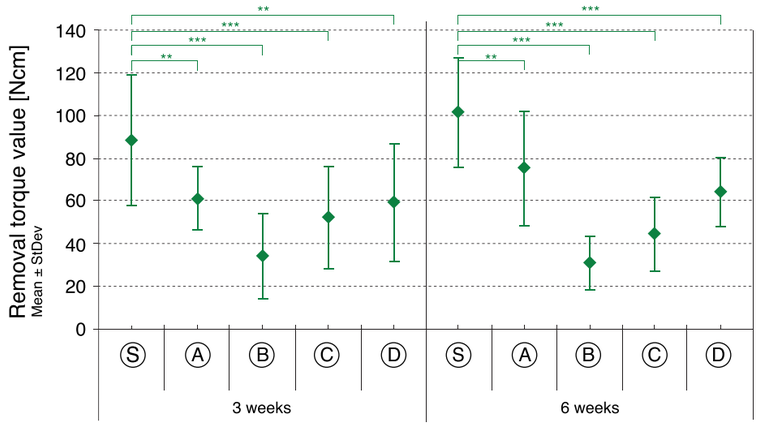

Figure 3 Mean removal torque values of test (S) and control implants (A –D) showing significant differences between test and all control implants for 3 and 6 weeks (**=p-value ≤0.01; ***=p-value ≤0.001, paired t-test).