

Influence of titanium implant surface characteristics on bone regeneration in dehiscence-type defects: an experimental study in dogs

Schwarz F, Sager M, Kadelka I, Ferrari D, Becker J.
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Abstract: Implants with either an SLActive® or a NanoTite™ surface were placed in dehiscence-type defects in dogs and underwent submerged healing for 2 or 8 weeks. Histomorphometric analysis showed comparable mean bone fill and mineralized tissue between groups. Greater new bone height and bone-to-implant contact were demonstrated for SLActive, suggesting (within the limits of this study) SLActive may have a higher potential to support osseointegration in dehiscence-type defects.

Introduction

The aim of the present study was to evaluate and compare bone regeneration in standardized dehiscence-type defects at implants with the SLActive surface or with a calcium phosphate nanoparticle-modified dual acid-etched surface (NanoTite, Certain®, Prevail®, Biomet 3i, FL, USA).

Methods

Standardized buccal dehiscence-type defects (height 4.0 mm, width 3.0 mm, depth 2.0 mm) were surgically created following implant site preparation in both upper and lower jaws of 12 dogs. Both SLActive and NanoTite implants were randomly assigned in a split-mouth design and left to heal in a submerged position. After 2 and 8 weeks, dissected blocks were processed for histomorphometric analysis (new bone height [NBH], percentage of bone-to-implant contact [BIC], area of new bone fill [BF], and area of mineralized tissue [MT] within BF). For the statistical evaluation of changes within groups over time, the paired t-test was used. For the comparisons between groups at each observation period, the unpaired t-test was used.

Results

Wound healing in both groups at 2 weeks was characterized by woven bone formation in the defect area. However, differences were observed in the bridging of the implant surface and defect margin by newly formed bone; woven bone was in close contact with the surface at SLActive implants, while BF areas were commonly separated from NanoTite implants by non-mineralized tissue.

After 8 weeks, continuous filling of the inter-trabecular spaces was observed in both groups, with slight-to-moderate superficial contour resorption, which appeared to be more pronounced in the NanoTite group, resulting in a significant decrease in mean BF.

Mean BF and MT were comparable between the groups, but NBH and BIC were significantly higher at the SLActive implants. Percent linear fill (PLF), defined as NBH divided by defect length (DL), was also significantly greater at SLActive implants (Table 1 and Table 2).

It should be noted that both types of implants revealed potential differences with respect to the macrodesign; therefore, the influence of individual design features on the outcome of healing cannot be estimated.

Groups	Weeks	DL	NBH	PLF	BF	MT	BIC	
modSLA	2	4.1 ± 0.2	2.6 ± 0.8 [†]	63.3 ± 19.6 [†]	2.4 ± 0.6	31.1 ± 14.3	55.8 ± 9.7 [†]	
	8	4.2 ± 0.1	3.6 ± 0.3 [†]	86.8 ± 7.2 [†]	2.3 ± 0.5 [†]	81.3 ± 9.4	78.2 ± 14.5	
		NS	p < 0.05	NS	NS	p < 0.001	p < 0.05	p value*
DCD/CaP	2	4.2 ± 0.2	0.9 ± 0.8	21.4 ± 19.0	2.0 ± 0.6	38.9 ± 15.9	20.3 ± 16.7	
	8	4.2 ± 0.1	1.8 ± 1.4	43.0 ± 34.9	1.6 ± 0.4	82.7 ± 8.8	47.2 ± 30.7	
		NS	NS	NS	p < 0.05	p < 0.01	NS	p value*

Table 1: Mean values for histomorphometric measurements (± SD) in the maxilla after 2 and 8 weeks for SLActive (modSLA) and NanoTite (DCD/CaP) implants

*Comparison within the groups (paired, t-test).

Comparisons between groups (unpaired t-test): [†]p < 0.05, [‡]p < 0.01

Groups	Weeks	DL	NBH	PLF	BF	MT	BIC	
modSLA	2	4.2 ± 0.1	2.4 ± 0.8 [†]	57.8 ± 19.9 [†]	2.3 ± 0.6	32.3 ± 7.3	53.5 ± 11.3 [†]	
	8	4.2 ± 0.2	3.4 ± 0.3 [†]	82.5 ± 9.2 [†]	2.5 ± 0.6	83.2 ± 8.2	79.5 ± 6.6 [†]	
		NS	p < 0.05	p < 0.05	NS	p < 0.001	p < 0.001	p value*
DCD/CaP	2	4.1 ± 0.2	0.8 ± 0.7	17.9 ± 17.6	2.1 ± 0.6	42.1 ± 11.0	19.3 ± 16.4	
	8	4.1 ± 0.1	1.7 ± 1.4	42.1 ± 34.4	1.4 ± 0.5	84.4 ± 6.3	43.3 ± 22.1	
		NS	NS	NS	p < 0.05	p < 0.001	NS	p value*

Table 2: Mean values for histomorphometric measurements (± SD) in the mandible after 2 and 8 weeks for SLActive (modSLA) and NanoTite (DCD/CaP) implants

*Comparison within the groups (paired, t-test).

Comparisons between groups (unpaired t-test): [†]p < 0.05, [‡]p < 0.01

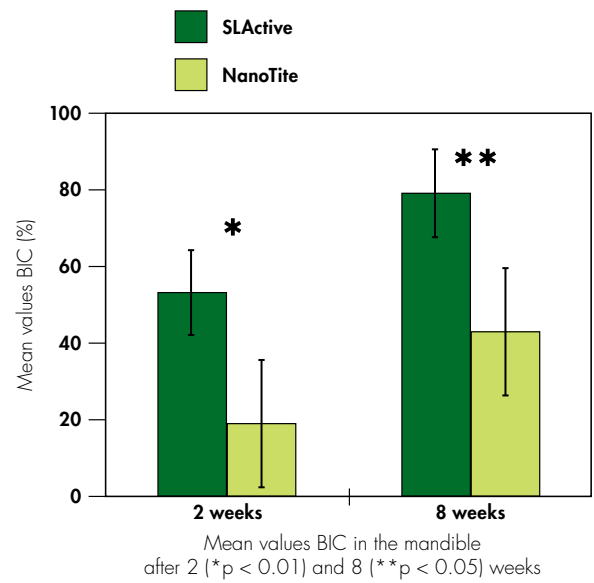
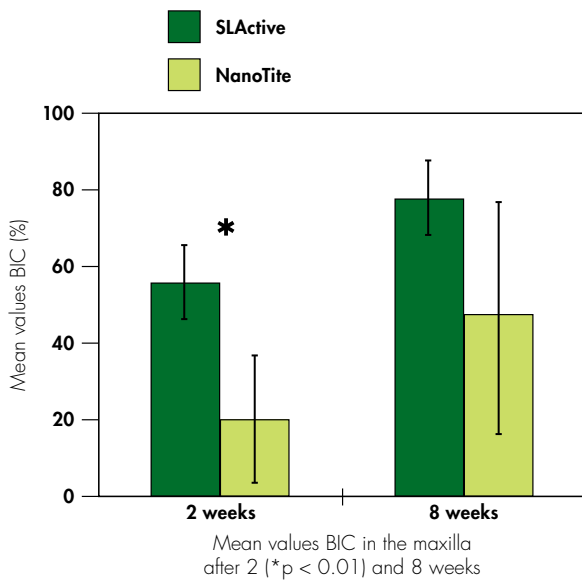


Fig. 3: Mean BIC values after 2 and 8 weeks in the maxilla and mandible

Conclusions

- Mean bone fill and mineralized tissue were comparable between groups
- New bone height was significantly higher for SLActive at both timepoints
- Bone-to-implant contact was significantly higher for SLActive compared to NanoTite at 2 weeks in the maxilla and at 2 and 8 weeks in the mandible
- SLActive implants may have a higher potential to support osseointegration in dehiscence-type defects than NanoTite implants

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