White Paper WP-5
Pre-clinical experimental study with SurfLink® Dental treated implants: SEM

1. Introduction

Different approaches have been proposed to improve direct bone-to-implant binding and mechanical interlocking for long-term dental implant fixation [1]. These strategies however, have fallen short of true osseointegration.

Histological and biomechanical analyses have shown SurfLink® Dental surface treatment by NBMolecules® to increase early stability and enhance early and late osseointegration of dental implants, as presented separately in the NBMolecules® series of White Papers [2,3].

Using Scanning Electron Microscopy (SEM) the aim of this study was to determine where fracture occurs when an implant is subjected to shear forces.

2. Materials and Methods

Dental implants were placed in the left and right pelvis of 24 sheep according to a well-established animal model [4]. This study used implants with a roughened[1] surface finish with either SurfLink® Dental treatment or no treatment (control). Animals were sacrificed after 2, 8 and 52 weeks. Selected implants, retrieved after 52 weeks healing, which were previously used for removal torque testing, were imaged by SEM (Oxford Instruments INCASynergy 350, equipped with Energy Dispersive X-ray analysis, EDX, Oxfordshire, UK).

3. Results

SEM analysis showed that bone tissue was present in several locations on the implant both in cortical and cancelleous bone regions. Increased bone coverage was observed on SurfLink® Dental treated implants compared to control implants. This was evidenced by the presence of mineralised fibrous structures (as Ca and P were detected by EDX) and bone cells spreading onto the implant surface (Figure 1A). Control implants mostly showed a denuded titanium surface (Figure 1B) similar to a pre-implantation titanium surface (Figure 1C).

SEM observations after torque testing consistently showed fracture lines within the bone for SurfLink® Dental treated implants (Figure 2A). By contrast, control implants separated at the bone-to-implant interface (Figure 2B). This separation is thought to be due to the presence of a viscous proteoglycan layer. Such a layer has been implicated in permitting implant micromotion [5].

The presence of a fracture line within the bone indicated the absence of such proteoglycan layer on the SurfLink® Dental treated implants.

4. Conclusion

SEM observations of SurfLink® Dental treated implants showed abundant bone coverage with fractures occurring within bone rather than at the bone to implant interface. This indicates a high degree of adaptation and adhesion integrating the SurfLink® Dental treated surfaces with the surrounding bone.

In the clinical situation, based on these results, SurfLink® Dental treatment should substantially improve implant stability and significantly diminish the risk of micromotion.

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Figure 1

A
B
C

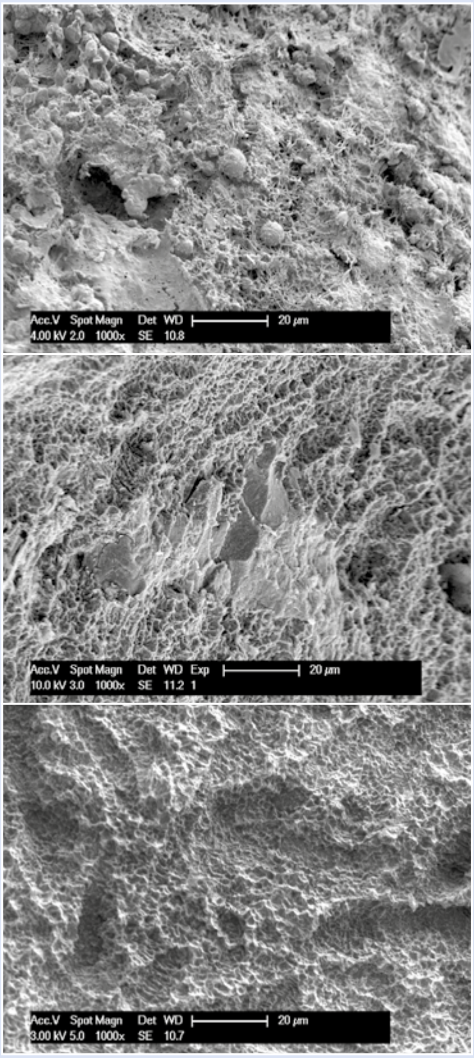

Figure 2

A
B

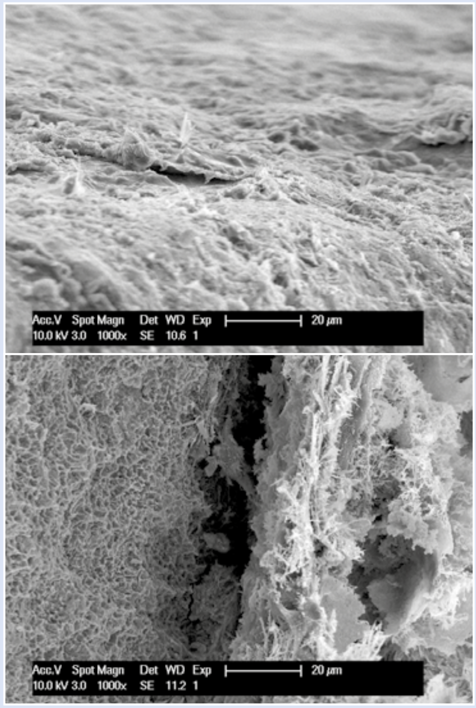

Figure 1: SEM of implants retrieved after 52 weeks: SurfLink® Dental treated implant surface showing cells attaching and spreading (A), control denuded implant surface (B), and pre-implantation pristine implant surface (C).

Figure 2: SEM of implants retrieved after 52 weeks showing fracture within bone on SurfLink® Dental treated implant (A), and separation at the bone-to-implant interface on control implants (B).

5. References

[1] L. Le Guéhennec et al., Dental Materials, **2007**, 23, 844-854.
[2] NBMolecules®' White Paper WP-4 Pre-clinical experimental study with SurfLink® Dental treated implants: Histology, **2011**.
[3] NBMolecules®' White Paper WP-6 Pre-clinical experimental study with SurfLink® Dental treated implants: Biomechanics, **2011**.
[4] J.D. Langhoff et al., Int. J. Oral Maxillofac. Surg., **2008**, 37, 1125-1132.
[5] T. Albrektsson, Australian Dental Journal, **2008**, 53, S34-S38.

Footnotes:

1 Roughened by sandblasting and dual acid etching. The roughened surface was chosen as representative of the most prevalent type of surface. Other surface finishes were also studied and results are presented elsewhere.

This document is part of a series of NBMolecules® White Papers (WP) covering in vitro, in vivo and clinical studies on SurfLink® Dental surface treatment. For the complete set of current White Papers, please consult www.SurfLink.info.

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