White Paper WP-9
Pre-clinical experimental study with SurfLink® Dental treated implants: Fluorescence Analysis

1. Introduction

Early bone formation at the implant surface is an essential requirement for implant stability and 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. Scanning Electron Microscopy (SEM) observations of SurfLink® Dental treated implants showed abundant bone coverage with fractures occurring within bone rather than at the bone to implant interface. These results are presented separately in the NBMolecules® series of White Papers [1,2,3].

Using Fluorescence Microscopy, the aim of this study was to investigate bone matrix mineralisation over time at the surface of SurfLink® Dental treated implants.

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. Intravital fluorochrome staining by subcutaneous injection was performed in the 2 week group at 11 days after surgery (Calcein-Green, green). In the 8 week group the fluorochromes were injected at 2 (Calcein-Green, green), 4 (Xylenol-Orange, dark orange), and 8 (Oxytetracyclin, yellow) weeks after surgery. Implants were cut into sections at the maximum diameter of the implant. Implants retrieved after 2 and 8 weeks were subjected to qualitative fluorescence analysis using a fluorescence microscope (Leica AF6000 DM6000 B TL (BF+)).

3. Results

The fluorescent images show areas labelled in green, orange and yellow indicating regions of bone matrix mineralisation at different time points.

Qualitative fluorescence analysis showed that early (11-14 days after implant insertion) bone matrix mineralisation occurs on the surface of SurfLink® Dental treated implants, as evidenced by the presence of a continuous green line at the bone to implant interface of the 2 and 8 week groups (Figures 1A and 2A, respectively). Orange and yellow lines are observed in the 8 week group in layers further away from the implant surface (Figure 2A). This indicates a continuous bone growth on the implant surface growing outwards towards the old bone, as seen in the SEM analysis [2]. This suggests that early implant fixation is the result of new bone growth from both the implant surface and the surrounding old bone.

Around control implant surfaces the new bone mineralisation appears mostly at the old bone site rather than at the implant surface (Figures 1B and 2B). This indicates that implant fixation in the absence of SurfLink® Dental surface treatment is more reliant on new bone growth from the surrounding old bone.

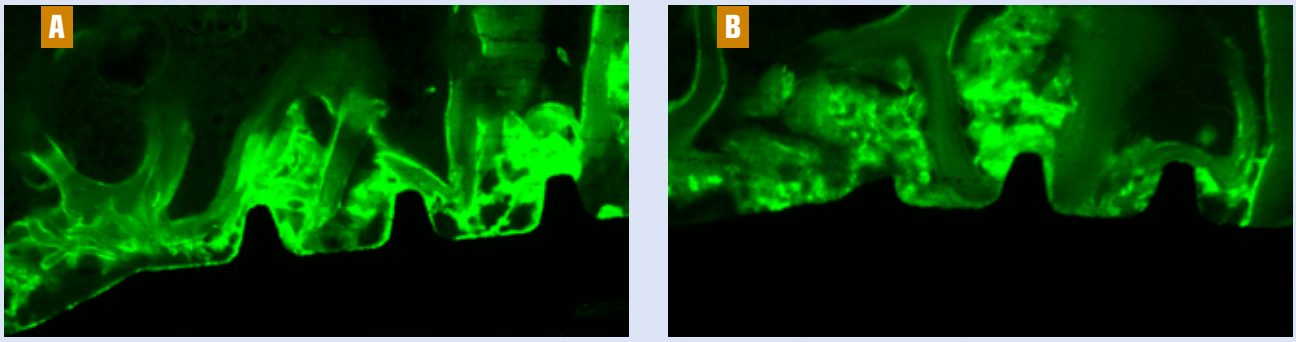

Figure 1: Fluorescent images of implants retrieved after 2 weeks: SurfLink® Dental treated implant (A) and control implant (B).

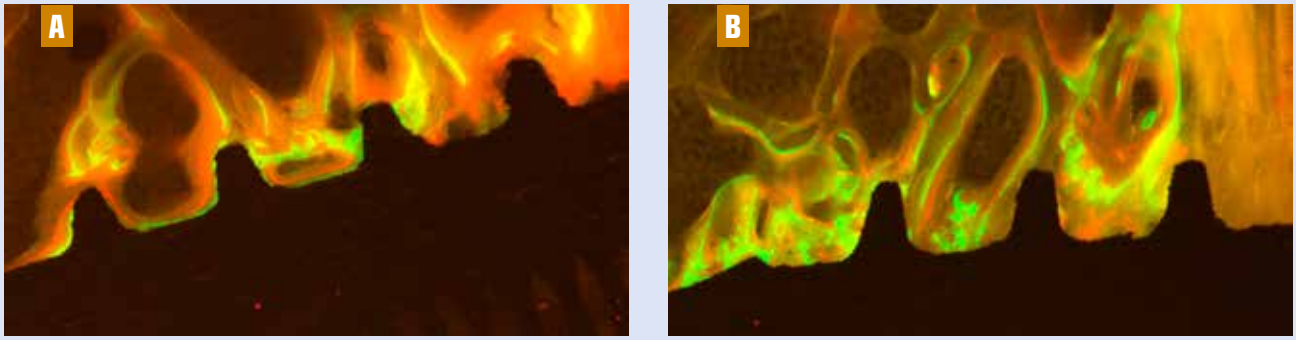

Figure 2: Fluorescent images of implants retrieved after 8 weeks: SurfLink® Dental treated implant (A) and control implant (B).

4. Conclusion

Qualitative fluorescence analysis showed that early bone mineralisation on the implant surface is encouraged by SurfLink® Dental surface treatment as opposed to conventional implant surfaces where integration mainly relies on bone growth from the surrounding old bone.

In the clinical situation, based on these results, SurfLink® Dental treatment would substantially improve implant osseointegration.

5. References

[1] NBMolecules®' White Paper WP-4 Pre-clinical experimental study with SurfLink® Dental treated implants: Histology, 2011.
[2] NBMolecules®' White Paper WP-5 Pre-clinical experimental study with SurfLink® Dental treated implants: SEM, 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.

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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