White Paper WP-4
Pre-clinical experimental study with SurfLink® Dental treated implants: Histology

1. Introduction

SurfLink® Dental surface treatment by NBMolecules® has shown the potential to establish a rapid and stable bone-to-implant interface in a series of experimental studies [1,2,3].

Biomechanical analysis and Scanning Electron Microscopy (SEM) imagery of the cells and bone structures occupying the bone-to-implant interface are presented separately in the NBMolecules® series of White Papers [4,5].

The aim of the present study was to assess osseointegration of SurfLink® Dental surface treated titanium implants by histological evaluation after 2, 8 and 52 weeks in sheep.

2. Materials and Methods

Dental implants were placed in the left and right pelvis of 24 sheep according to a well-established animal model [6]. 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. Implants were retrieved for radiological, macroscopic examinations, as well as semi-quantitative histological assessment of Bone-to-Implant Contact (BIC) and bone formation (histomorphometry) [6].

3. Results

Overall implant integration was assessed by microradiograph imagery. A thin continuous seam of mineralised tissue was observed around all SurfLink® treated implants after 2 weeks (Figure 1), but only occasionally around non-treated implants.

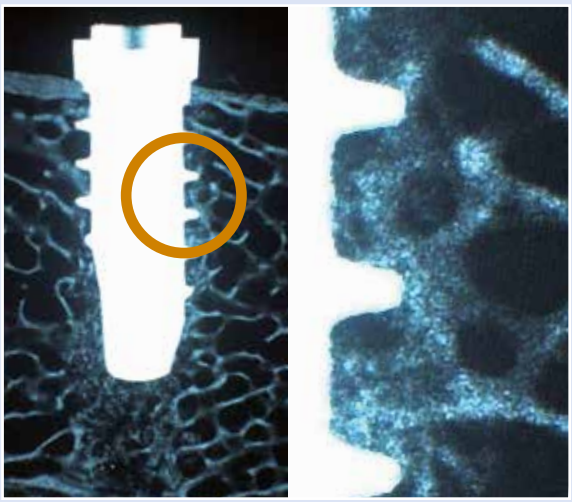

Figure 1: Microradiographic image of a SurfLink® treated implant at 2 weeks demonstrating a thin continuous seam of mineralised tissue.

Preliminary evaluation of fluorochrome labelling at 2 weeks after implantation clearly showed bone forming in direct contact to the SurfLink® treated surfaces, as opposed to control surfaces.

At 8 and 52 weeks the implants showed no signs of fibrous encapsulation, and the radio-dense zone in close contact to the implants, showed no bone resorption beyond normal remodelling.

Over the duration of the study no sign of inflammation or other adverse events were observed and all implants were clinically stable.

Histological analysis showed that implants from all groups were partially or fully surrounded by cortical and cancellous bone after 2, 8 and 52 weeks (Figure 2).

In cancellous bone at 2 weeks, SurfLink® Dental treated implants showed greater integration over control implants, as evidenced both by a higher new bone formation (+43% New/Old bone)[2] and slightly higher BIC values (+3%)[2]. This is a significant observation, as over time, failure rates are more commonly caused by a lack of implant stability from the cancellous bone.

Significant production of new bone occurred between 2 and 8 weeks and BIC values were lower at 8 weeks around all implants. These findings are indicative of active bone remodelling.

At 8 weeks, SurfLink® Dental treated implants showed a 13%[2] increase in new bone formation over control implants. After 52 weeks bone remodelling appeared to slow down, with mature lamellar bone structures seen around dental implants of all groups. Compared to control implants, SurfLink® Dental treated implants showed a 39%[2] increase in BIC values.

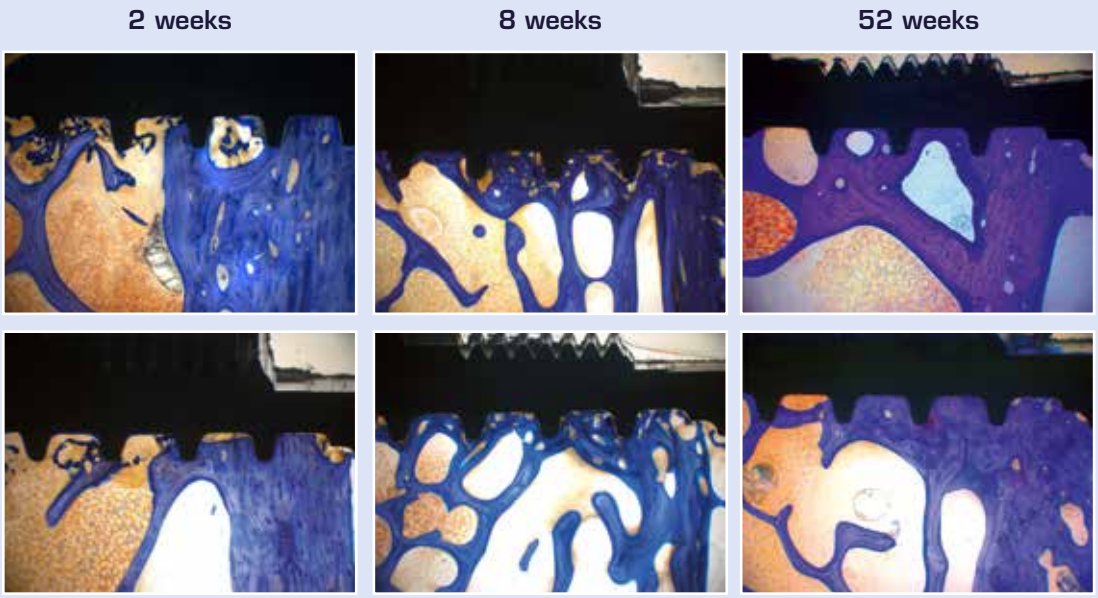

Figure 2: Histological comparison of SurfLink® Dental treated and control roughened implants after 2, 8 and 52 weeks. For the SurfLink® treated implants, substantially more bone resulted in increased long-term BIC.

4. Conclusion

Histological and radiographic evidence clearly showed, even by 2 weeks, that SurfLink® Dental treatment prompted early bone formation on and around the implant surface. And, at 52 weeks, SurfLink® Dental treated implants showed a considerably greater bone-to-implant contact.

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

5. References

[1] C. Viornery et al., J. Biomed. Mater. Res., **2002**, 62, 149–155.
[2] R. Dayer et al., Bone, **2005**, 36, S389 (P561).
[3] NBMolecules®' internal reports, unpublished.
[4] NBMolecules®' White Paper WP-5 Pre-clinical experimental study with SurfLink® Dental treated implants: SEM, **2011**.
[5] NBMolecules®' White Paper WP-6 Pre-clinical experimental study with SurfLink® Dental treated implants: Biomechanics, **2011**.
[6] J.D. Langhoff et al., Int. J. Oral Maxillofac. Surg., **2008**, 37, 1125-1132.

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.

2 Outcome parameters were evaluated by pairing test implants (surface treated) with the corresponding control in the same animal and statistically evaluated with a one-sample Wilcoxon test, with $p<0.05$ for significance.