Peri-implant Biofilm Formation on Luting Agents Used for Cementing Implant-Supported Fixed Restorations: A Preliminary In Vivo Study

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This study investigated subgingival peri-implant biofilm formation on four luting agents (Kerr TempBond, Harvard Dental Harvard Cement, 3M ESPE RelyX Unicem, and Kuraray Panavia F 2.0) under realistic in situ conditions. Samples of the luting agents were positioned in the subgingival area of healing abutments, and the biofilm accumulation on the samples at the interface between luting agent and titanium and on the smooth titanium surface was investigated using scanning electron microscopy. In comparison to plane titanium surfaces, interfaces between implant abutment, cement, and suprastructure showed an increased bacterial accumulation and should therefore be regarded as predisposing substrates for peri-implant biofilm formation. *Int J Prosthodont 2015;28:371–373. doi: 10.11607/ijp.4100*

A cement-induced peri-implant imflammatory response—so-called cementitis or peri-implantitis when accompanied by adverse marginal bone changes—represents a common clinical problem in cement-retained implant-supported fixed restorations.[1,2] In fact, first signs of peri-implant inflammation become visible a few weeks after the cementation of the prosthetic suprastructure.[3] The potential of the different luting agents used in implant dentistry to accumulate bacterial biofilms has not yet been fully investigated. To the best of our knowledge, no in vivo studies exist that focus on the peri-implant adhesion of biofilms on luting systems and their influence on the development of peri-implant inflammation. The aim of this study was to investigate subgingival biofilm formation on four clinically established luting agents (Kerr TempBond, Harvard Dental Harvard Cement, 3M ESPE RelyX Unicem, and Kuraray Panavia F 2.0) under realistic in situ conditions and to develop clinically relevant material recommendations.

Materials and Methods

A convenience sample of 17 patients with two or more healing abutments was included in this study. The study was approved by the Ethics Committee of the Faculty of Medicine, University of Regensburg (application number 11-101-0037). Fifty-nine conventional titanium healing abutments were individualized. A cavity measuring 2 mm in width and 2 mm in depth was drilled into the two outer opposite surfaces and into the subgingival area of the healing abutment with a carbide drill. A luting agent sample was applied to each cavity according to the manufacturer's instructions (Fig 1). TempBond-Harvard samples and RelyX Unicem–Panavia F 2.0 samples were always applied in pairs at the two opposite surfaces of a healing abutment. After the healing of the peri-implant soft tissue the modified healing abutments were incorporated. All samples were strictly positioned subgingivally. The test healing abutments were investigated by scanning electron microscopy after 10 days (Figs 2 and 3).

Results

Most of the surface of the subgingival luting agent samples was covered with biofilm in each of the four luting agents tested. The interfaces between sample and titanium were also largely covered with biofilm. No

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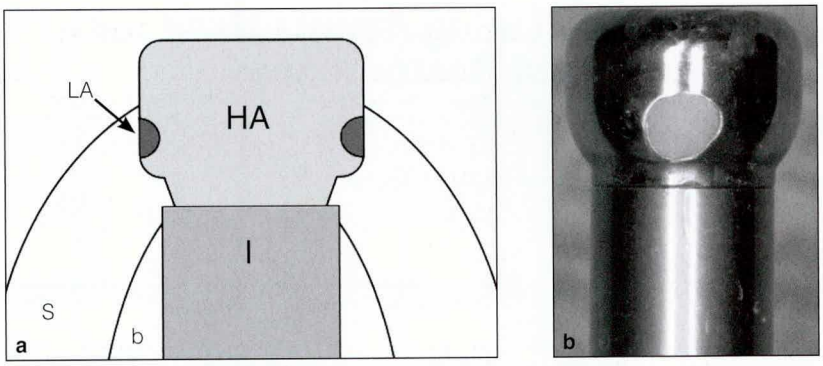

Fig 1 **(a)** Graphic representation of the luting agent's (LA) position on the healing abutment (HA) and **(b)** image of an individualized healing abutment fixed onto an implant (I). S: soft tissue; b: alveolar bone.

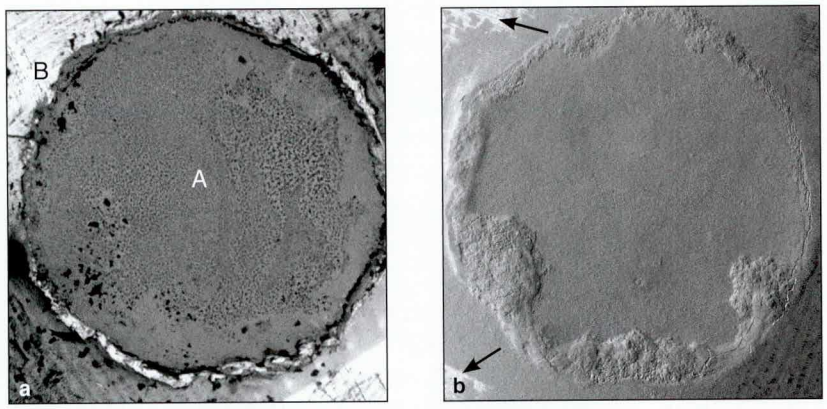

Fig 2 Scanning electron micrograph of the luting agent sample (A) and the interface sample-titanium (B) before **(a)** and after **(b)** in vivo biofilm formation. After the wearing period, the sample area and the adjacent titanium surface were fully covered with dense biofilm. The titanium marginal areas *(arrows)* were covered with less biofilm.

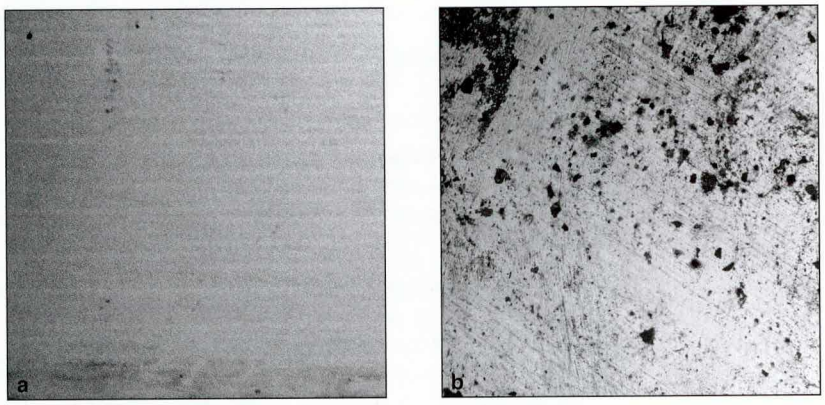

Fig 3 Scanning electron micrograph of the smooth titanium surface before **(a)** and after **(b)** the wearing period. Biofilm colonization was significantly lower than on the luting agent samples and the adjacent titanium surfaces.

statistical differences were observed among the four types of luting agents used in this study with respect to biofilm colonization, neither on the sample surface nor at the interface sample-titanium. Subgingival biofilm colonization on the smooth titanium surface of the healing abutments was statistically significantly lower than on the luting agent samples and the interface sample-titanium surfaces. Table 1 shows the percentage values for biofilm coverage of the luting agent samples, the interface sample-titanium, and the smooth titanium surface.

Discussion

To the best of our knowledge, no in vivo studies have yet been published investigating the adhesion of peri-implant biofilms on luting agents, although the relation between cement residues and resulting peri-implant infection is clinically well documented.[1–3]

The present in situ study succeeded in realistically simulating the in vivo situation of cement-retained implant-supported restorations. The results showed that the interface between the abutment, the cement,

Table 1 Biofilm Coverage (%) of the Luting Agent Sample, the Interface Sample-Titanium, and the Smooth Titanium Surface (Mean ± SD)*

Samples	Luting agent	Interface sample-titanium	Smooth titanium surface
TempBond	89.4 ± 11.9	87.7 ± 13.6	
Harvard Cement	91.6 ± 8.2	89.4 ± 13.1	
RelyX Unicem	84.0 ± 15.6	83.5 ± 16.3	
Panavia F 2.0	87.4 ± 12.8	83.3 ± 16.3	
TempBond/Harvard Cement			53.7 ± 24.6
RelyX Unicem/Panavia F 2.0			48.0 ± 19.3

*Differences in the bacterial colonization of the sample surface and the interface sample-titanium among the four luting agents investigated were not statistically significant ($P > .05$). The differences in bacterial colonization of the smooth titanium surfaces were statistically significant for both groups of luting agents ($P < .05$).

and the suprastructure in the subgingival region represents a critical area because it offers ideal conditions for bacterial accumulation and biofilm formation.

The study showed increased biofilm accumulation in the interface between the abutment, the cement, and the suprastructure. The biofilm's proximity to the crestal alveolar bone is a factor that may negatively affect the development and progression of peri-implantitis. The aim of cement-retained fixed implant-supported restorations is relocating the marginal gap away from the crestal alveolar bone by means of a suitable abutment design. Very deep-lying restoration margins also contribute to cement residues that are difficult to remove. The deeper in the peri-implant sulcus the restoration margin lies, the larger the amount of proven cement residues that act as a biofilm niche.[4]

We could clearly show that biofilm accumulation—that was found to differ among various luting agents in previous in vitro studies[5]—did not differ under realistic in vivo conditions. In addition, the potential to accumulate subgingival biofilms was found to be significantly higher for luting agent surfaces than for smooth titanium surfaces. In almost all healing abutments investigated, biofilm coverage affected not only the actual luting agent sample but also the adjacent titanium surface.

Conclusions

This preliminary study's findings reinforce the hypothesis that residual cement and the interface titanium-cement restoration could play a greater role in the pathogenesis of peri-implant inflammation than previously thought.

Acknowledgments

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