Reuse of Implant Healing Abutments: Comparative Evaluation of the Efficacy of Two Cleaning Procedures

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Purpose: To compare the efficacy of two systems in cleaning used healing abutments (HAs). ***Materials and Methods:*** A total of 60 used HAs were randomized into two groups: one treated with an automatic cleaning system, and the other with conventional decontamination procedures. After sterilization and staining, the HAs were microscopically analyzed and underwent a cellular adhesion in vitro assay. ***Results:*** Contaminated areas were observed with different frequencies in the two groups (3.6% test; 78.2% control; $P < .001$). In vitro assay showed a uniform cell distribution in test HAs, while areas of debris without adhering cells were a common finding in the control HAs. ***Conclusion:*** Further studies investigating the chemical composition and clinical influence of biologic remnants are necessary before considering reusing HAs. *Int J Prosthodont 2018;31:161–162. doi: 10.11607/ijp.5552*

While implant healing abutments (HA) are indicated for a single use, economical considerations encourage the apparent practicality of their sterilization and reuse. However, this strict step in the titanium clinical management protocol appears to be incomplete,[1] and the merit of HA reuse is now questioned. A recently proposed three-step approach to automatically clean and decontaminate HAs includes ultrasonic soaking, tumbling by rotating metal pins, and ion pasteurization. The aim of this preliminary study was to test the null hypothesis that no difference in cleaning efficacy exists between this novel device and conventional cleaning/decontamination procedures.

Materials and Methods

HAs were collected at the time of prosthesis delivery after at least 1 month of clinical use. Two HAs with the same dimensions (Megagen) were retrieved from each patient, obtaining pairs of identical HAs with similar oral environmental conditions to be randomized into two groups by coin toss. HAs in the first group (referred to as the control group) underwent mechanical wiping with disinfection sponges followed by a 30-minute ultrasonic bath, while HAs in the second group (referred to as the test group) were treated with an automatic cleaning system (Meg Cleaner, Megagen). Finally, the HAs were separately packaged and sterilized for 20 minutes at 134°C (200 kPa) (Vacuklav 31-B, Melag).

Quantitative analyses were carried out under a light stereomicroscope at ×10 magnification (MZ-16, Leica Microsystems) by two calibrated examiners (F.B. and T.L.) by dividing each HA into 15 predefined areas and following a previously reported protocol using a protein-specific stain (phloxine B 1.5% w/w).[2] Furthermore, HAs were placed in a 24-well plate with 1 mL of a cell suspension of Fibroblast 3T3 (ATCC CRL-1658 at 40,000 cell/mL concentration). After 48 hours, specimens were fixed, dehydrated, and sputtered with gold for scanning electron microscope analysis (SEM) (Quanta250 SEM, FEI). After applying the Kolmogorov-Smirnov test to assess data normality, descriptive analyses were conducted with chi-square and Mann-Whitney tests. Post hoc analysis was performed to evaluate statistical power (R Version 3.3.1, R Foundation for Statistical Computing). The level of statistical significance was pre-set at $\alpha = .05$.

Results

A total of 66 HAs were retrieved from 33 patients for quantitative analysis, and 9 HAs (3 from each of the two groups and 3 brand new ones) were used for cellular adhesion in vitro assay.

Proteic contamination was present in 11 HAs of the test group (11/30) and in all of the control HAs (30/30) (Fig 1), resulting in a statistically significant difference between groups ($P < .001$). More specifically, signs of proteic debris were detected in 16 out of 450 evaluated areas in the test group (3.6%) and in 352 out of 450 areas in the control group (78.2%) ($P < .0001$) (Fig 2).

SEM analysis showed homogenous cell distribution on the surfaces of both brand new abutments

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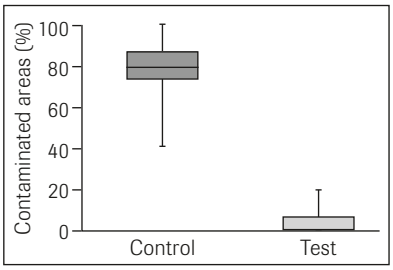

Fig 1 *(Left)* Healing abutments in the control group showing traces of proteic contamination in all 15 examined areas (Phloxine B 1.5% w/w).

Fig 2 *(Right)* Box plot describing distribution of the percentage of contaminated areas in the test and control groups. Mann-Whitney test demonstrated significant differences between groups ($P < .001$).

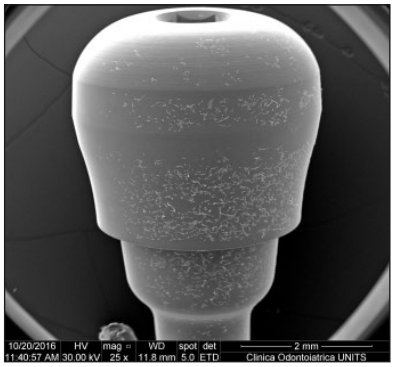

Fig 3 Brand new healing abutment showing extensive adhesion and homogenous distribution of cultured fibroblasts (magnification: ×25)

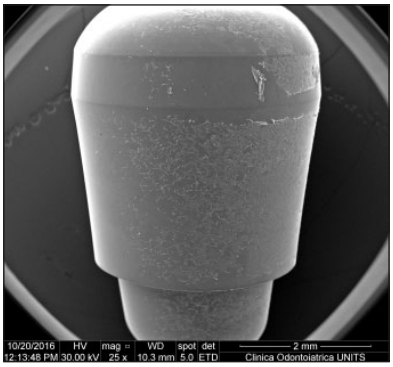

Fig 4 Healing abutments in the test group showing fibroblast spreading and distribution comparable to brand new healing abutments (magnification: ×25).

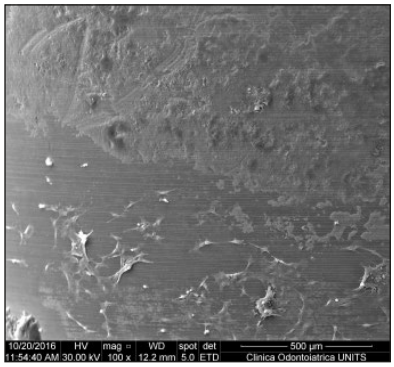

Fig 5 Areas of biologic debris preventing cell adhesion were a common finding in the control group (magnification: ×100).

and test group abutments (Figs 3 and 4), while areas of debris without adhering cells were a common finding in the control group (Fig 5). Even in the control group, however, cells were distributed uniformly in debris-free areas, similar to the test abutments.

Discussion

It has been shown that used HAs, even after sterilization, may still present multiple contaminants; in particular, proteic debris is characterized by a strong adhesion to titanium surfaces and is extremely difficult to remove with conventional cleaning procedures.[2]

HAs are reported to play an important role in soft tissue healing. Surface topography variations could interfere in this process, as a clean surface has higher free energy and wettability, favoring cell adhesion and spreading.[3,4] The present in vitro analyses confirmed these observations: Fibroblasts did not colonize the contaminated areas of HAs, while their growth was regular and their distribution uniform on clean surfaces of both new and used components. Furthermore, biologic debris could theoretically become a vector of indirect transmission for pathogenic prions, even after performing conventional sterilization procedures.[5,6]

The analyses performed in this study confirmed previously published data on the ineffectiveness of conventional procedures in decontaminating used HAs,[2] while the tested device resulted in efficiently cleaning more than 95% of the evaluated surfaces. However, this preliminary study has limitations, including use of a convenience sample size, examination of only one type of HA, and that no precise identification of the proteic contaminants or evaluation of their possible role on tissue healing were undertaken. These items need to be thoroughly investigated before considering reusing HAs in clinical practice.

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