Scanning electron microscopic examination of customized titanium abutments before and after different cleaning procedures

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Abstract

Aim: The aim of this study was to assess the degree of contamination on customized titanium abutments after processing in the dental laboratory. In order to figure out the highest cleaning efficiency, abutments were examined before and after different cleaning and disinfection procedures.

Methods and Materials

Forty abutments of the type Ankylos Balance anterior small 3.0/0 (Dentsply Implants) underwent a standardized laboratory procedure and were afterwards randomly divided into three groups: group A (10 abutments), group B (15 abutments) and group C (15 abutments). Group A was cleaned solely with a disinfecting solution consisting of MD 520, chlorhexidine and water. Group B was cleaned in addition to the disinfecting solution used in group A with an ultrasonic cleaner. Lastly, the ultrasonic cleaner and an acetone-containing solution were utilized for group C. Contamination was measured before and after the cleaning procedures by electron microscopy (SEM Hitachi S 4500). The percentage share of the contaminated area was calculated for each group and cleaning efficiency was determined by using the Wilcoxon-Matched-Pairs-Test. The Wilcoxon-Mann-Whitney-Test was applied to compare the cleaning efficiency between the different groups. Statistical significance was obtained when $p \leq 0.5$.

Results

The analysis of group A, which showed an average percentage share of contamination of 30.5 % before cleaning and of 27.5% after cleaning, failed to reveal any statistical significant cleaning efficiency. The use of ultrasonic cleaning in group B, with an average percentage share of contamination of 26.3% before cleaning and of 5.3% after cleaning, achieved statistical significance with a p-value of $p = 0.000061$. Nevertheless, the combination of an ultrasonic cleaner with an acetone-containing solution led to the highest cleaning efficiency in group C, which had an average percentage share of contamination of 31.7% before cleaning and of 1.25% after cleaning ($p = 0.000061$).

III 1. Screw thread of a customized titanium abutment after cleaning with steam, before cleaning with a disinfecting solution

III 2. Screw thread of customized titanium screw after ultrasonic cleaning and an acetone-containing solution

Group A (10 abutments): Contamination (%) before cleaning with different mediums (MD 520, CHX, H2O)	Contamination (%) after cleaning	Difference (%)
MD 520		
25	18	7
30	24	6
27	22	5
CHX		
45	43	2
24	21	3
32	30	2
H2O		
35	35	0
30	29	1
26	26	0
Group C (15 abutments): Contamination (%) before ultrasonic cleaning and an acetone-containing solution	Contamination (%) after ultrasonic cleaning and an acetone-containing solution	Difference (%)
19	1,5	17,5
16	1	15
32	3	29
19	0,2	18,8
37	1,7	35,5
53	1,8	51,2
44	0,6	43,3
33	1,8	31,2
28	1	27
25	0,7	24,3
31	1,8	29,3
36	0,8	35,2
37	1	36
33	0,9	32,1
33	1	32

Conclusions

This study confirmed the presence of contamination after mechanical processing of customized titanium abutments. The analysis of different cleaning procedures showed that the exclusive employment of cleaning solutions without an ultrasonic cleaner has the lowest cleaning efficiency. Using an ultrasonic cleaner in combination with a disinfecting agent or solution can achieve sufficient cleaning efficiency in contaminated customized abutments.

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