Implant Abutment Screw Reverse Torque Values Before and After Plasma Cleaning

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This in vitro study analyzed the reverse torque ($R_{ev}T$) of abutment screws following different cleaning treatments. A convenience sample of 50 customized titanium abutment screw complexes was divided into five groups: cleaning by steam (control group), cleaning by Argon plasma (test groups 1 and 2 [with chlorhexidine gel]), and replacement of old screws with new ones (test groups 3 and 4 [with chlorhexidine gel]). Abutments were screwed onto implants and tested for $R_{ev}T$. The $R_{ev}T$ of the test groups was significantly higher than that of the control group. No statistically significant difference between test groups was noted except between groups 2 and 3. *Int J Prosthodont 2013;26:331–333. doi: 10.11607/ijp.3396*

Developments in implant materials and techniques have not precluded the abutment screw loosening that appears to be a relatively frequent mechanical complication.[1] The stability of an implant-abutment connection may affect the prognostic outcome and depends on connection design, compatibility of employed materials, component fit, salivary or other forms of contamination, and screw preload.[2] It is postulated that the presence of debris on the abutment/screw complex following technical/clinical procedures could decrease the friction coefficients of the employed components and affect the preload. This preliminary in vitro study analyzed reverse torque ($R_{ev}T$) values as a means of indirectly measuring the preload[3] of implant connection screws following different cleaning procedures.

Materials and Methods

A convenience sample of 50 commercially available grade 5 titanium abutment/screw complexes (3.8 mm in diameter, Premium, Sweden & Martina) was customized (Fig 1) and divided into five groups of 10 each. The first group was treated by laboratory steam cleaning and used as the control group (Fig 2). Abutment/screw complexes cleaned by Argon plasma (Fig 3) were used alone in test group 1 and with a chlorhexidine gel (Dentosan Gel, Johnson & Johnson) for test group 2. In test groups 3 and 4, screws used during customization were replaced with new ones, alone and with chlorhexidine gel, respectively.

A new implant for every abutment was locked in a precision tool with the electronic screwdriver coaxial to the abutment. Abutments were connected to a torque measuring machine (TQ-8800, LT, Lutron) (Fig 4). Screws were tightened with a torque of 20 Ncm at 5 rpm; tightening was repeated after 10 minutes. After an additional 60 seconds, the screwdriver was turned back and the peak of $R_{ev}T$ measured.

For all groups, mean and standard deviation (SD) values $R_{ev}T$ were calculated. Comparisons were performed by Wilcoxon signed-rank test. Statistical significance was set at $P \leq .05$.

Results

Single values, means, and SDs of $R_{ev}T$ are reported in Table 1. The Wilcoxon test revealed statistically significant differences between the control and test groups (Table 2). Test group 4 (new screws) presented significantly higher values compared with test group 2 (screws cleaned by Argon plasma with chlorhexidine). No statistically significant difference was found when comparing the other test groups (Table 3).

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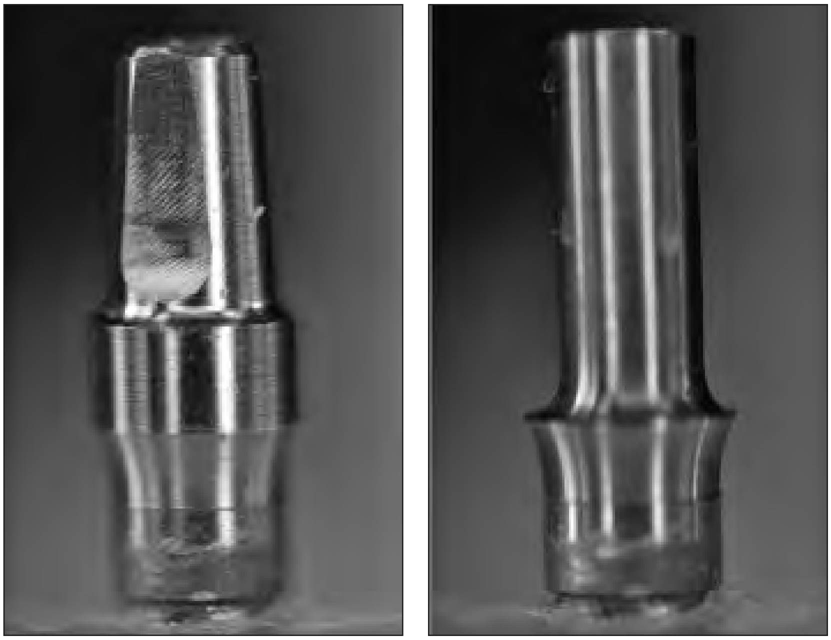

Fig 1 The titanium abutments *(left)* before and *(right)* after customization by means of carbide burs (coarse and fine) followed by steam cleaning.

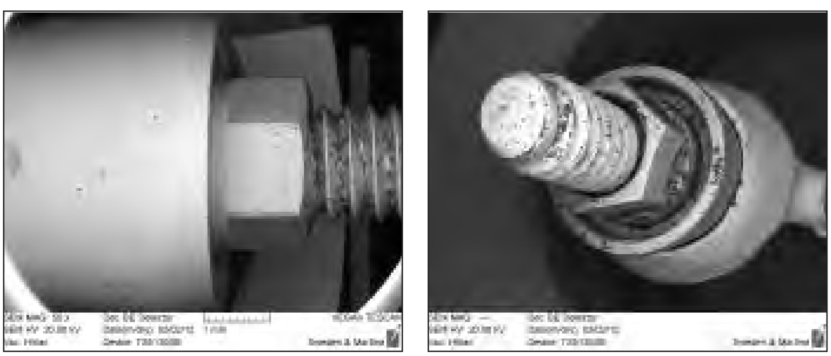

Fig 2 Scanning electron microscopy (SEM) images of abutment/screw complex after steam cleaning; *(left)* lateral and *(right)* apical views (original magnification ×50).

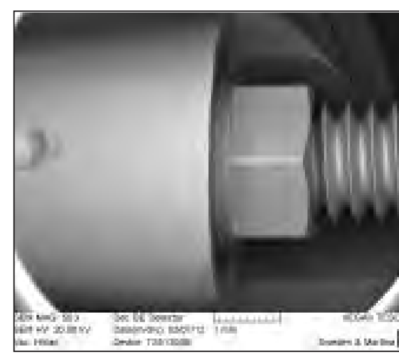

Fig 3 SEM image of abutment/screw complex after Argon plasma cleaning; note the absence of micropollutants (original magnification ×50).

Fig 4 The measurement device with aluminum implant holder and the coaxial holder of the screw-driver joined to the torque meter and the electric engine.

Table 1 Reverse Torque Values Measured on the 10 Abutments

Abutment no.	Control group	Test group 1	Test group 2	Test group 3	Test group 4
1	12	23	23	18	19
2	23	20	23	22	22
3	11	24	19	21	21
4	22	20	22	25	26
5	18	28	21	29	24
6	21	26	21	26	27
7	21	24	22	29	20
8	16	18	20	25	25
9	21	24	22	23	19
10	16	19	19	24	24
Mean	18.1	22.6	21.2	24.2	22.7
Median	19.5	23.5	21.5	24.5	23.0
SD	4.22	3.23	1.47	3.42	2.90

SD = Standard deviation.

Table 2 Wilcoxon Test*

Control vs group 1	Control vs group 2	Control vs group 3	Control vs group 4
0.0156	0.042	0.0023	0.011

*When applied to the reverse torque values, statistically significant differences were reached between the control and test groups.

Table 3 Differences Between the Four Test Groups

Groups					
1 vs 2	1 vs 3	1 vs 4	2 vs 3	2 vs 4	3 vs 4
0.2295	0.2973	0.9429	0.0204*	0.163	0.3051

Wilcoxon test used.
*Significant difference.

Discussion

Preload, or the tension generated in the screw upon tightening, is a direct and critical determinant of clamping force that prevents screw loosening. Experimental reports show that a lower joint preload causes significantly greater micromotion connection that may lead to unexpected time-dependent clinical outcomes. The preload is affected by factors such as intensity and modality of torque application, design and material of implant-abutment components, environmental conditions that affect material interactions (lubrication of mating surfaces) and screw settling, plus the presence of surface irregularities that prevent maximum contact between screw and abutment.

Irregularities and pollutions at the connection/screw complex are reported as produced during laboratory procedures, while an Argon plasma cleaning protocol was shown to be effective in the complete removal of pollutants from the abutment/screw complex. Steam cleaning, on the other hand, only reduced debris contaminants. Moreover, both perfectly cleaned screws as well as new ones showed 15% to 25% higher $R_{ev}T$, which confirmed reported observations that showed that 2% to 10% of the initial preload is lost as a result of the settling effect.[4,5] Chlorhexidine gel failed as a lubricant since it reduced $R_{ev}T$ values; in fact, comparisons between new screws alone and plasma cleaned ones with gel suggested statistical significance.

Possible clinical treatment outcome implications of preliminary observations are unclear. However, it is tempting to suggest that optimal prognoses may be compromised, and further study of this research initiative is encouraged.

Conclusions

Within the limitations of this study, the obtained data strongly suggest that complete removal of pollutants derived from implant abutment customization improves preload maintenance of the abutment/screw complex. The preliminary data underscore the use of debris-free screws to minimize abutment screw loosening.

Acknowledgment

The authors reported no conflicts of interest related to this study.

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