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Screw Loosening with Interchangeable Abutments in Internally Connected Implants After Cyclic Loading

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Introduction

Some abutments available on the market fit on implants that are not from the same manufacturer and make it possible for the user to create non-original implant-abutment connections. The purpose of this study was to compare loosening of interchangeable abutments including original Straumann® Abutments after cyclic loading.

Materials and methods

Four groups of different implant-abutment connections were tested. The Straumann® Ø 4.1 RN implant was used in this study. For each group different abutments were used.

Group 1: 5.5 mm Straumann® Solid Abutment, made of titanium grade 4 (Ti 4)

Group 2: 5.5 mm Lifecore Biomedical Inc. Restore® RDS COC Abutment, made of $TiAl_6V_4$ (TAV)

Group 3: 5.5 mm Neobiotech Neoplant Solid Abutment, made of titanium grade 4 (Ti 4)

Group 4: 5.5 mm Osstem AVANA Solid Abutment, made of $TiAl_6V_4$ (TAV)

Test specimens were assembled, abutments tightened to 35 Ncm and subjected to a cyclic load of 150 N at a frequency of 6 Hz for 1 million cycles. The angle between each load and the axis of the implants were fixed at 30 degrees.

The periotest values (PTV) were measured before and after the cyclic loading. In addition, the removal torque values (RTV) were measured after the cyclic loading. The periotest values show how much the abutment moves within the implant, and the removal torque values show how much torque is required to remove an abutment.

Results

PTVs before cyclic loading	Straumann® Solid Abutment	Lifecore Restore® COC Abutment	Neoplant Solid Abutment	Osstem AVANA Solid Abutment
Mean (± SD)	**−4.00 ±0.00**	**−4.43 ±0.53**	**−4.71 ±0.57**	**−4.57 ±0.58**

Table 1: *Periotest values (PTV) before cyclic loading*

No significant difference in PTVs between groups before cylic loading (Table 1). ($P > .05$)

PTVs after cyclic loading	Straumann® Solid Abutment	Lifecore Restore® COC Abutment	Neoplant Solid Abutment	Osstem AVANA Solid Abutment
Specimen 1	−4	+1	+16	+14
Specimen 2	−3	+5	Screw fracture	+9
Specimen 3	−3	+2	Screw fracture	+6
Specimen 4	−3	+2	Screw fracture	Implant fracture
Specimen 5	−4	+7	Screw fracture	Implant fracture
Specimen 6	−3	+11	Screw fracture	Implant fracture
Specimen 7	−4	+13	Screw fracture	Implant fracture
Mean (± SD)	**−3.43 ±0.53**	**+5.86 ±4.71**	**+16.00 ±0.00**	**+9.67 ±4.04**

Table 2: *Periotest values (PTV) after cyclic loading*

After cyclic loading (Table 2), the mean PTV of Straumann® Solid Abutments on Straumann® RN implants was statistically significantly lower than those of Lifecore Restore® COC Abutments and those of Osstem AVANA Solid Abutments, both on Straumann® RN implants.[1] Because six of the seven Neoplant Solid Abutments fractured, it was not possible to make comparisons between groups.

RTVs after cyclic loading	Straumann® Solid Abutment	Lifecore Restore® COC Abutment	Neoplant Solid Abutment	Osstem AVANA Solid Abutment
Specimen 1	40.5	30.0	12.0	15.0
Specimen 2	34.0	21.0	Screw fracture	20.0
Specimen 3	33.0	26.5	Screw fracture	21.0
Specimen 4	32.0	28.0	Screw fracture	Implant fracture
Specimen 5	35.0	20.0	Screw fracture	Implant fracture
Specimen 6	34.0	19.0	Screw fracture	Implant fracture
Specimen 7	35.0	15.0	Screw fracture	Implant fracture
Mean (± SD)	**32.74 ± 2.74**	**+22.79 ± 5.46**	**+12.00 ± 0.00**	**+18.67 ± 3.21**

Table 3: *Removal torque values (RTV) after cyclic loading*

The RTVs of Straumann® Solid Abutments were statistically significantly higher than with Lifecore Restore® COC Abutments and Osstem AVANA Solid Abutments.[2]

Straumann® Solid Abutments and Restore® COC Abutments did not exhibit any fractured implants or abutments. The Straumann® Solid Abutments yielded better results for RTVs and PTVs after cyclic loading than the other groups. Thus, it appeared to be the most stable and resistant to the loosening of a screw when assembled on a Straumann® RN implant.

Neoplant Solid Abutments exhibited six fractures (screw fractured) and the Osstem AVANA Solid Abutments showed four fractured implants.

The author of this study assumed that the reason for such outcomes was most likely that the different chemical and compositions and physical characteristics of the implant system components of each group differed, even though all the abutments could be combined with each other.

Conclusion

Although some abutments fit on implants that are not from the same manufacturer, they possess different chemical compositions and physical characteristics. The use of an abutment and implant manufactured by the same company is recommended to prevent loosening of the abutment screw. This study does not provide enough data to support a definitive analysis. However, the results of this work show the potential risk when apparently interchangeable implants and abutments are used.

[1]Kruskal-Wallis test, P = .003; one-way ANOVA, P < .05
[2]Kruskal-Wallis test, P = .002; one-way ANOVA, P < .05

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