Retrievability Of Implant-Retained Splinted Or Non-Splinted Crowns Following Semipermanent Cementation

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Objectives

Cementation of implant-supported fixed restorations is a common procedure in implant dentistry. However, removal of such restorations can be necessary due to technical or biological complications1,2. The aim of this in vitro study was to investigate the retrievability of two splinted or non-splinted (single) implant-retained crowns using two different removal devices and the impact of five cement types.

Material and Methods

Three conical titanium implant abutments (5° taper, 6mm height, 4.3mm diameter, CAMLOG Biotechnologies AG, Switzerland) were each fixed on parallel placed lab analogues in altogether 30 light-curing composite models.

For the removal tests with A) a universal testing machine (Zwick® 2030, Germany) and B) an air-powered pull-off device (CORONAflex®, KaVo, Germany) each group of 30 frameworks was divided into 2 groups (n=15). The Zwick® device directly measured the force (Newton) needed to extract the construction (Retention force). For CORONAflex® the number of removal attempts until successful retrieval of the construction was documented.

Table 1 Cements

<table>
<thead>
<tr>
<th>Proprietary material</th>
<th>Type</th>
<th>Manufacturer</th>
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<tbody>
<tr>
<td>Freegenol</td>
<td>Eugenol-free, zinc oxide</td>
<td>GC, Japan</td>
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<tr>
<td></td>
<td>cement: provisional</td>
<td></td>
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<tr>
<td>Improv™ Temp. Impl. Cem.</td>
<td>Provisional resin cement</td>
<td>Alvelogro Inc., USA</td>
</tr>
<tr>
<td>Xpand Implant Cement</td>
<td>Dual-curing semi-permanent resin cement</td>
<td>Cumdenteme, Germany</td>
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<tr>
<td>Dyna Implant Temp Cement</td>
<td>Dual-curing semi-permanent resin cement</td>
<td>Dyna Dental Engineering BV, Netherlands</td>
</tr>
<tr>
<td>Telio® CS Cem Implant</td>
<td>Dual-curing semi-permanent resin cement</td>
<td>Ivoclar Vivadent, Liechtenstein</td>
</tr>
</tbody>
</table>

After cementation, specimens were stored in saline-solution at 37°C for 72 hours (n=30) or were subjected to thermocycling (n=30) (10,000 cycles at +5°C and +55°C).

Results

One-way analysis of variance (ANOVA) revealed significant influence of splinting, type of cement and thermocycling on retention force (P<0.05).

Conclusions

There are significant differences in retention forces between different types of cements for semipermanent fixation. Thermocycling results in a strong reduction of retention force for all tested cements while splinting increases retention forces.

Acknowledgements

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References

2. Fjettersøn B.E. et al. (2012), A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FPDs) after a mean observation period of at least 5 years. Clin. Oral Implants Res. 23 (Suppl.6): 22-38.

Fig. 1: Preparation of the standardized titanium abutments with a parallel milling machine. (a) Use of a cutting disk adjusted to shorten the abutment to a length of 6mm. (b) Use of a bur adjusted to mill a tapered groove at length of 5 mm and depth of 0.5 mm for anti-rotation lock. (c) Parallel placed lab analogues with mounted abutments in one of the thirty composite models (2x4x1cm).

Fig. 2: (a) Wax up of a framework with the modeling of anchorage loops on the top. (b) A cast and elaborated framework mounted on one implant analogue on one of the composite models to simulate a single crown. (c) Another framework mounted on two adjacent implant analogues to simulate two splinted crowns.

For the tests 30 frameworks (n=30) were successively cemented with eugenol-free, zinc-oxide and so-called resin cements according to the manufacturers’ instructions for use (Table 1). Before cementation the inner surfaces of the copings were sandblasted (Al2O3, 50µm, 2bar), whereas titanium abutments were used as delivered (machined surfaces).

Fig. 3: (a) Standardized cementation of the frameworks with a 5kg load for 10 min for each cement (here example of cementing all 3 “crowns”). (b) Pulling-off test by using a universal testing machine (Zwick®): here simulation of a single crown removal. Pulling-off approach directly on the top of one implant. (c) Removal of a framework simulating a situation of two splinted crowns. Pulling-off approach between two neighboring implants.

Fig. 4: Application of the CORONAflex® system to remove a framework simulating two splinted crowns. Removal attempts started at lowest powerful level with 10 “kicks” (5 from mesial and 5 from distal end). If not succeeded, further 10 (5/5) applications were performed at a medium power level of the system. Finally, attempts were performed at highest level until successful removal of the constructions.

Fig. 5: Box plots of the retention forces measured by Zwick® for the single and two splinted crown samples without (stored in saline) or with thermocycling and for all 5 cements (n=15/group). The median, 25th and 75th percentile, lowest and highest values are shown. Horizontal lines indicate significant differences (P < 0.05).