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 complications[1,2]. 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.

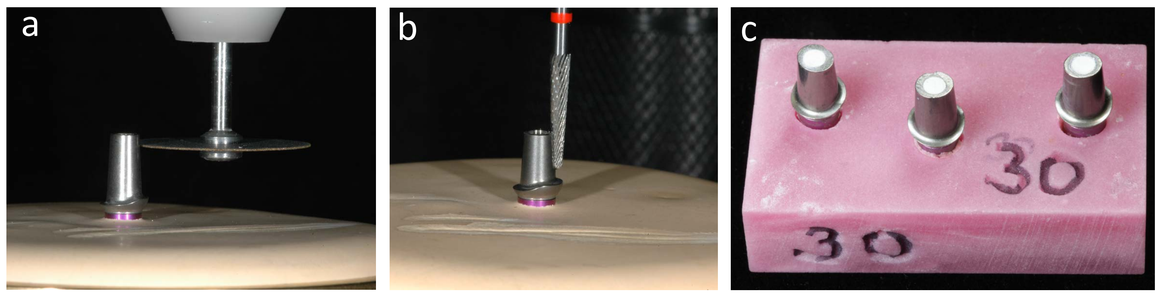

Fig. 1: Preparation of the standardized titanium abutments with a parallel milling machine. (a) Use of a cutting disk adjusted to shorten the abutment to a length of 6mm. (b) Use of a bur adjusted to mill a tapered groove at length of 5 mm and depth of 0.5 mm for anti-rotation lock. (c) Parallel placed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

Frameworks simulating three-unit-bridges were designed and cast from CoCr-alloy so that metal loops could be mounted for pull-off movements. The construction allowed the simulation of splinted or non-splinted single crowns.

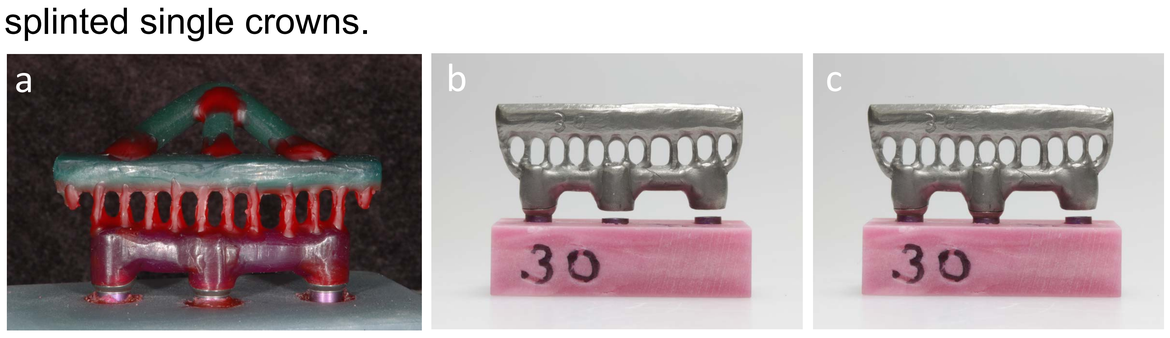

Fig. 2: (a) Wax up of a framework with the modeling of anchorage loops on the top. (b) A cast and elaborated framework mounted on one implant analogue on one of the composite models to simulate a single crown. (c) Another framework mounted on two adjacent implant analogues to simulate two splinted crowns.

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 (Al_2O_3, 50µm, 2bar), whereas titanium abutments were used as delivered (machined surfaces).

Table 1	Cements	
Proprietary material	Type	Manufacturer
Freegenol	Eugenol-free, zinc oxide cement; provisional	GC, Japan
Improv™ Temp. Impl. Cem.	Provisional resin cement	Alvelogro Inc., USA
Xpand Implant Cement	Dual-curing semi-permanent resin cement	Cumdente, Germany
Dyna Implant Temp Cement	Dual-curing semi-permanent resin cement	Dyna Dental Engineering BV, Netherlands
Telio™ CS Cem Implant	Dual-curing semi-permanent resin cement	Ivoclar Vivadent, Liechtenstein

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° and +55°C).

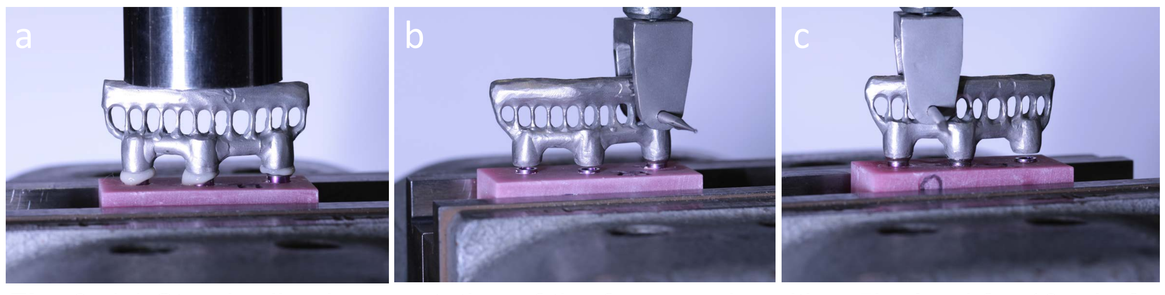

Fig. 3: (a) Standardized cementation of the frameworks with a 5kg load for 10 min for each cement (here example of cementing all 3 "crowns"). (b) Pulling-off test by using a universal testing machine (Zwick®): here simulation of a single crown removal. Pulling-off approach directly on the top of one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

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For the removal tests with A) a universal testing machine (Zwick® Z030, 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 removal of the construction was documented.

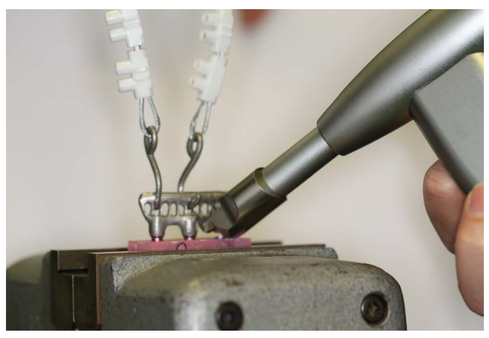

Fig. 4: Application of the CORONAflex® system to remove a framework simulating two splinted crowns. Removal attempts started at lowest powerful level with 10 "kicks" (5 from mesial and 5 from distal end). If not succeeded, further 10 (5/5) applications were performed at a medium power level of the system.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

Results

One-way analysis of variance (ANOVA) revealed significant influence of splinting, type of cement and thermocycling on retention force ($P<0.05$). The order of highest retention force was generally correlating with the removal attempts by Coronaflex®, except for the cements Freegenol and Improv™ at splinted crowns without thermocycling.

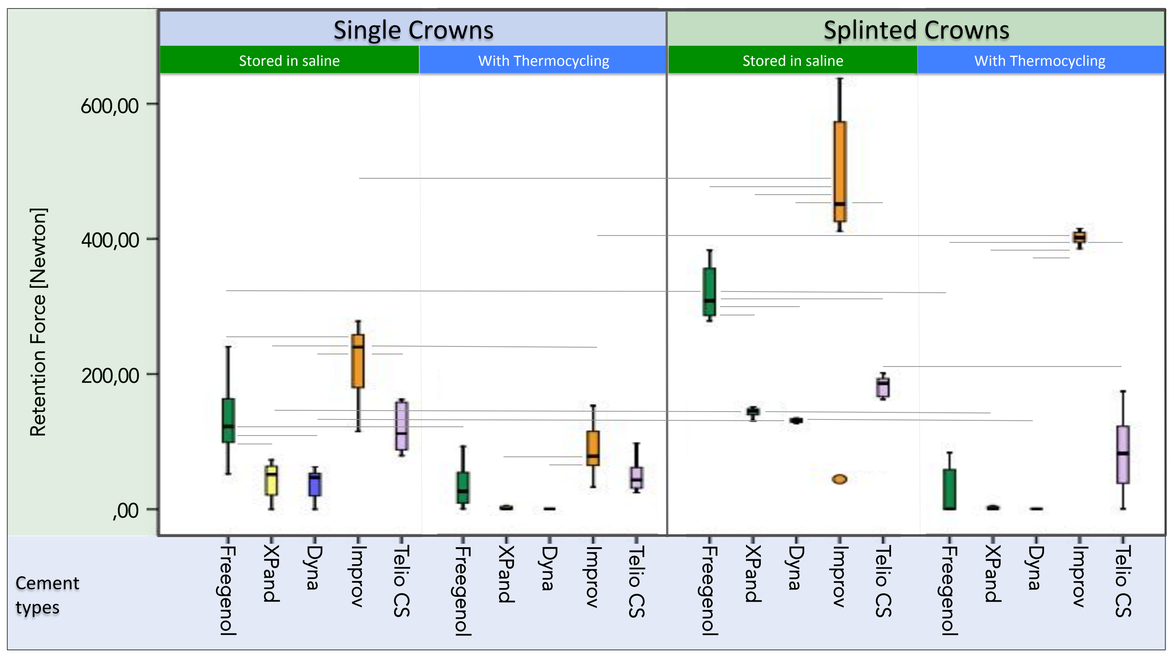

Fig. 5: Box plots of the retention forces measured by Zwick® for the single and two splinted crown samples without (stored in saline) or with thermocycling and for all 5 cements (n=15/group). The median, 25th and 75th percentile, lowest and highest values are shown. Horizontal lines indicate significant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

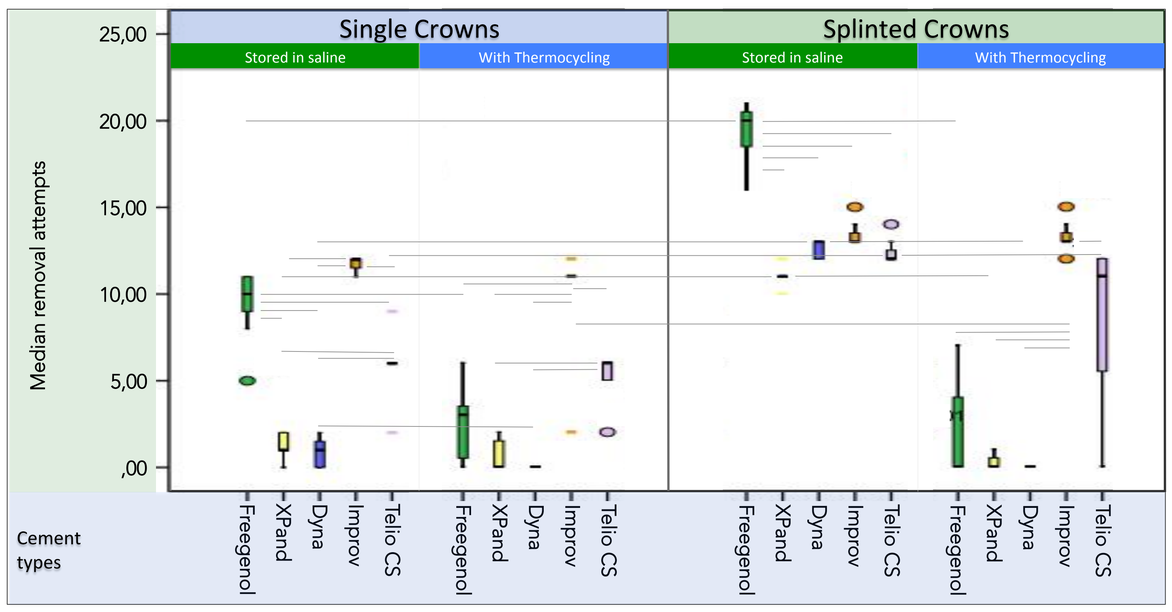

Fig. 6: Box plots of the number of attempts needed by CORONAflex® to remove the single and two splinted crown samples without (stored in saline) or with thermocycling and for all 5 cements (n=15/group). The median, 25th and 75th percentile, lowest and highest values are shown. Horizontal lines indicate significant differences ($P < 0.05$).

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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1. Chaar M.S. et al. (2011), Prosthetic outcome of cement-retained implant-supported fixed dental restorations: a systematic review. J Oral Reh 38(9): 697-711
2. Pjetursson B.E. et al. (2012), A systematic review of the survival and complication rates of implant-supported fixed dental prostheses (FDPs) after a mean observation period of at least 5 years. Clin. Oral Implants Res. 23 (Suppl.6): 22-38