In vitro standardization of two different removal devices in cemented implant prosthesis

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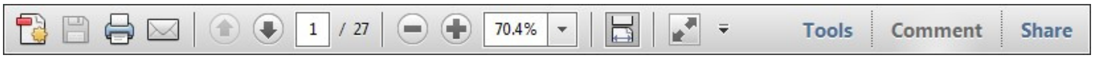

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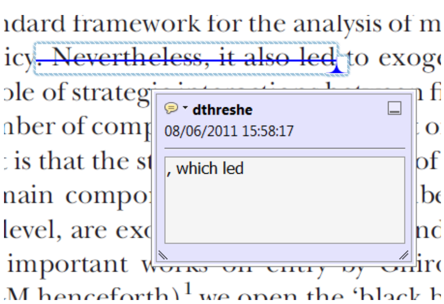

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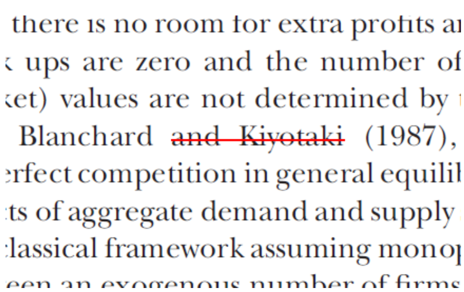

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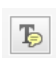

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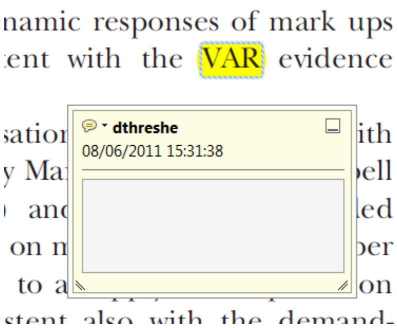

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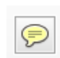

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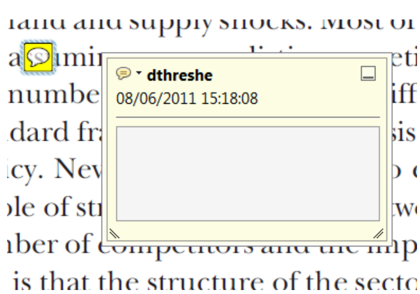

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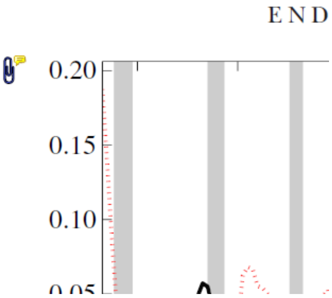

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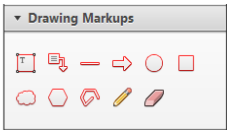

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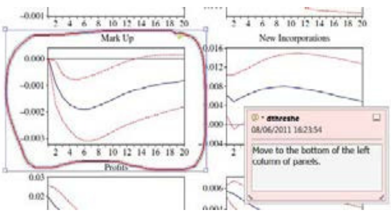

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In vitro standardization of two different removal devices in cemented implant prosthesis

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Key words: Coronaflex®, FDP, force transducer, implant prosthesis, reverse hammer

Abstract

Objectives: The purpose of this study was to describe the force generated by two different removal devices used to retrieve cemented crowns on implant abutments. The influence of six different operators was evaluated.

Material and methods: Three replicated Coronaflex® (Kaltenbach & Voigt GmbH, KaVo Dental GmbH) and reverse hammer setups were tested. The experimental setup has employed a screw bearing a diametral hole through which a loop holder passed. The screw was attached to a force transducer (Brüel & Kjær, type 8201), and the loop holder arm was kept perpendicular to the transducer axis. The results were statistically evaluated with ANOVA.

Results: The operator has resulted to play significant influence with reference to reverse hammer (coefficient of variation 43.3%) rather than with Coronaflex® (9.8%). Evaluating every single operator, more variation can still be found by considering each reverse hammer (37.5%) rather than each Coronaflex® (8.8%).

Conclusion: Coronaflex® device was found to systematically reach a more repeatable and higher peak amplitude of forces compared with reverse hammer, both by experienced and inexperienced operators.

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Introduction

Cemented prosthesis on implants is widely used because of simple manufacturing technique, improved esthetics (Chee et al. 1999; Taylor et al. 2000), potential of passive fit (Chiche & Pinault 1991; Guichet et al. 2000), lower complication rate (Assenza et al. 2005) and a higher fracture resistance of the veneering ceramic (Torrado et al. 2004).

Implant-supported fixed dental prostheses (FDPs) are made of a metal–ceramic or zirconia crown luted onto a transmucosal abutment, which is connected to the implant. The transmucosal abutments can be either pre-machined or customized from noble alloy, titanium, zirconia, or reinforced ceramics. The longevity of these restorations is strongly influenced by the shape and the size of the transmucosal abutments, the different cements available (Akca et al. 2002), and the materials of which prostheses and abutments are made (Hebel & Gajjar 1997; Chee et al. 1998).

While retrievability is not a main concern when permanently cementing FDPs on natural teeth or screwing crowns to implants, when a cementation is performed on implant abutments, surrounding conditions and clinical implications change completely: such problems as the abutment screw loosening or fracturing may require an easy and safe crown decementation (Mehl et al. 2012a, 2012b). 3

Here, some factors play an important role in order to achieve a suitable compromise between stability of retention and retrievability (Mehl et al. 2008).

The height and the taper of implants abutments and the type of cement influence the retention of the restoration (Bresciano et al. 2005; Mehl et al. 2012a,b).

Even the cement film thickness has an influence on the retention of implant-cemented crowns (Mehl et al. 2008).

Many authors recommend the use of provisional cements to facilitate retrievability of the crowns without damaging the restoration or the implant and its abutment. For these purposes, the cement should be strong enough to indefinitely avoid an intraoral debonding of the prosthesis, yet weak enough to allow the dentist to retrieve it in case of need (Breeding et al. 1992; Mehl et al. 2013).

Some devices are commercially available for removing FDP on implants and their characteristics and correct use may play an important role on the retrievability of implant-cemented crowns. But few information is available for the clinician on how much these devices really work (Mehl et al. 2012a,b) and differ from each other.

The purpose of this study was to analyze the forces produced by two popular removal devices (the Coronaflex® and the reverse hammer) and their repeatability.

Material and methods

The plan for the experiments considered six tools (three replicated setups both for Coronaflex® and hammer extractors) and six operators (three dental practitioners and three inexperienced operators). Each experiment was identified by the respective tool, the experimental setup, and the operator and was repeated 40 times at regular intervals lasting 3 s.

On the whole, 1440 trials have been performed ($2 \times 3 \times 6 \times 40$).

ANOVA test has been used to assess the influence of the employed tool, the experimental setup, the operator, and their interaction.

Coronaflex® tool

Coronaflex® is a device manufactured by Kaltenbach & Voigt GmbH, distributed by KaVo
4 Dental GmbH and intended solely for procedures in the dental medicine (Fig. 1a). In the intention of its designer, it allows to perform rapid, effective, secure crown extractions; in most cases, the prosthesis remains intact after removal and can therefore be re-used, with an evident economic advantage.

The energy source is compressed air; operating pressures range from 3 to 5 bar. The pressure does not affect the force generated by this tool, but just pushes a plunger toward the tip of the extractor. As the operator finger closes the nozzle at the top of the instrument, a short pulse is generated; this pulse fractures the cement and allows prosthesis removal. The impact force can be easily set by the operator turning the knurled knob at the rear of the device; in fact, the regulation of the knurled knob varies the compression of the plunger.

The Coronaflex® is equipped with various accessories in order to allow an optimal extraction of any type of fixed prosthesis; these accessories include a forceps, a clamp and a loop with the respective loop holder.

In particular, this article refers to the extraction using the loop in Fig. 1b: this device is the most suitable for the removal of frontal and lateral components of the bridges. First, it is introduced under the bridge, as close as possible to one of its pillars; secondly, it is secured by the special loop holder, where the impact force is applied. The same operations are then repeated next to each pillar. The whole procedure is repeated until the complete removal of the bridge.

Reverse hammer (custom-made removal devices)

The reverse hammer (Fig. 2) belongs to the category of manual instruments.

Commercially different types of reverse hammer are available, all manufactured and working with the same principles: they are made of a steel rod, and a concentric mobile mass, whose shape and weight can vary from a hammer to another; various tips can be attached to the rod end, depending on the FDP to be removed and its location in the dental arch. The hammer tip is positioned between two crowns; the moving mass is then thrown along its guide, producing small strokes in the direction of the shutdown; consecutive stokes are given in a short period of time to produce the mobilization of the prosthesis.

In the case of dental bridges, the extraction force is applied on each of its pillars in turn.

Instrumentation

The experimental setup has not made use of copings or crowns, but has employed a screw bearing a diametral hole (Fig. 3) through which the loop holder passed. The screw has been attached to a force transducer (Brüel & Kjær, type 8201). The loop holder arm has been kept perpendicular to the transducer axis, through an opposite fixture.

Signal analysis

A typical signal produced by Coronaflex® has been reported in Fig. 5; it is made of two components: the pulse itself, which is the object of this inquiry, and an extinguishing oscillating response caused by the dynamic response of the load cell; these two signals overlap in the first phase, and this is the reason why the peak is not symmetric and its amplitude could be wrongly estimated.

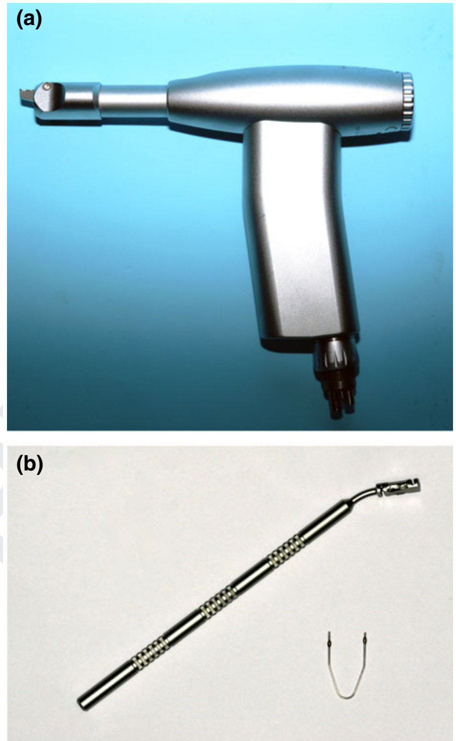

Fig. 1. Coronaflex® (a) and (b) its loop holder for the extraction of dental crowns.

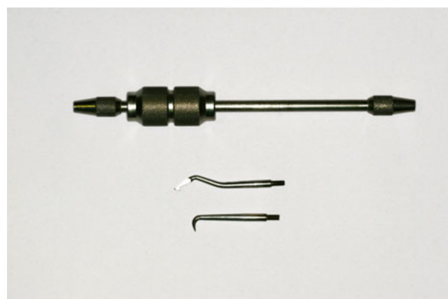

Fig. 2. Reverse hammer.

The frequency analysis has leaded to discard the hypothesis of filtering out noise with traditional techniques (low-pass, high-pass or band-pass filters) because the respective spectra overlap. A different procedure has therefore been followed: the pulse peak has been identified and the signal has been made symmetrical with respect to this point. The curve so produced (Fig. 4) has been interpolated with a 6th degree polynomial, and the peak width has been so established.

Statistical analysis

~~Two~~ null hypotheses have been formulated with reference to the significance of the operator, of the removal tool and of the experimental setup on the peak removal force.

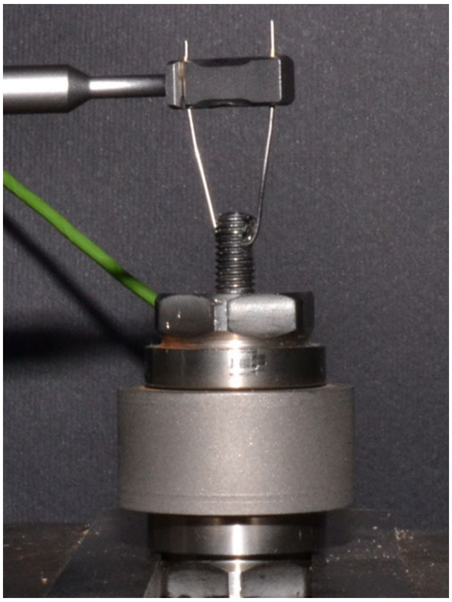

Fig. 3. Experimental setup. From bottom to top: load cell, drilled screw, and loop holder.

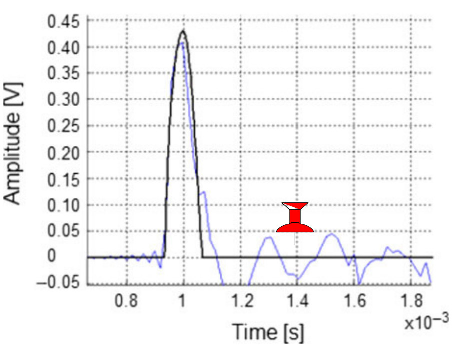

Fig. 4. Signal interpolation for the estimation of peak amplitude.

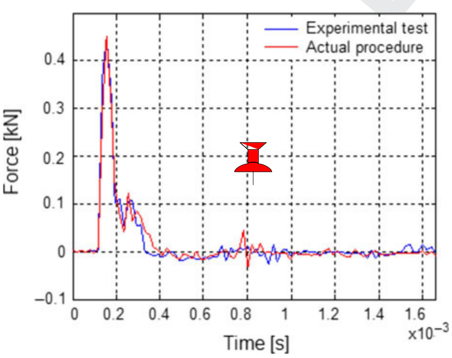

Fig. 5. Force patterns for an experimental test and for the actual procedure.

The analyzed factors were therefore the crown removal tool (two levels, fixed factor), the experimental setup (this factor is nested in the preceding one, it has three levels, and it is a random factor), the operator (six levels, random factor) with their interaction; forty repetitions have been performed for each experiment.

Table 1. **Indices of variability: numbers in bold represent the maximum and minimum value for each kind of tool**

	CORONAflex 1	CORONAflex 2	CORONAflex 3
Operator 1	5.223	6.553	5.383
Operator 2	4.843	3.759	6.6
Operator 3	4.257	5.794	4.594
Operator 4	7.428	6.542	4.412
Operator 5	6.518	4.104	**3.683**
Operator 6	5.326	5.285	**7.622**
Among All Operators	8.007	8.057	9.840
	Reverse Hammer 1	**Reverse Hammer 2**	**Reverse Hammer 3**
Operator 1	22.094	30.974	**33.583**
Operator 2	29.299	25.996	23.017
Operator 3	33.307	14.407	16.933
Operator 4	22.196	17.951	23.254
Operator 5	31.033	12.275	**10.399**
Operator 6	16.465	25.008	19.523
Among All Operators	29.218	34.938~~1~~	43.315

Table 2. **ANOVA: boldface text has been used for significant factors**

Factors	SS [N2]	dof	MS [N2]	Fexperim	Significance
Crown removal tool	19,822,764	1	19,822,764	300.527	0.590
Experimental set up/(Crown removal tool)	**263,840**	**4**	**65,960**	**1.089~~528~~**	**0.001**
Operator	229,520	5	45,904	0.758~~242~~	0.388
Operator × Crown removal tool	**1,574,880**	**5**	**314,976**	**5.20~~2775~~**	**0.003**
Operator × Experimental set up	**1,210,800**	**20**	**60,540**	**51.91~~403~~**	**<0.001**
Error	1,637,287	1404	1166~~.158832~~		
Total	24,739,091	1439	1719~~1.8631~~		

Results

Preliminary tests have been performed in order to simulate that this experimental setup could faithfully reproduce the actual procedure (Fig. 5).

These preliminary tests have demonstrated that the input pressure has no influence on the amplitude of the signal produced by Coronaflex®; therefore, this pressure has been set equal to 4 bar.

Statistical results of ANOVA analyses are reported in Table 2 and will be described in the following.

Results repeatability

The replication of tests, with the same operator using the same tool, has proven that the peak amplitude of forces reached by Coronaflex® is much more repeatable compared with the reverse hammer (Table 1): a coefficient of variation (the ratio of the standard deviation to the mean) ranging from 3.7% (operator 5, Coronaflex® 3) to 7.6% (operator 6, Coronaflex® 3) has been measured, against 10.4% (operator 1, reverse hammer 3) to 33.6% (operator 5, reverse hammer 3) measured employing reverse hammer.

Operator influence

The operator has not resulted to play a significant influence (Table 2): differences among peak forces produced by various operators are minor when compared to the effects of the main factor, that is the crown removal tool. However, with reference to Coronaflex® tool, changing operator produces a coefficient of variation up to 9.8% (Table 1), while, with reference to reverse hammer, the coefficient of variation has resulted to be much higher, reaching 43.3% (Table 1).

Images of signals obtained by different operators have been reported in Fig. 6: even when the peak amplitude is the most similar (this was the criterion followed to choose one single test out of 40 replications, for each operator), the pattern of the signal can be very different in the case of the reverse hammer.

Tool and experimental setup influence

The employed tool has resulted to play a significant influence (Table 2), while the experimental setup does not produce significant variations. However, with reference to

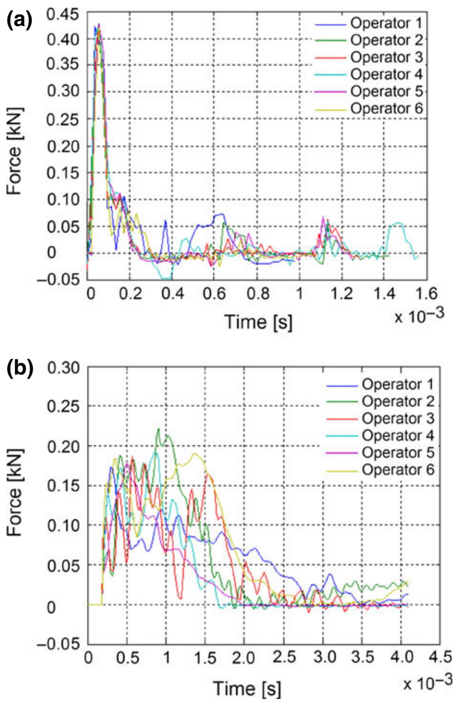

Fig. 6. Force pattern vs time, produced by different operators in the case of Coronaflex® tool (a) or the reverse hammer (b).

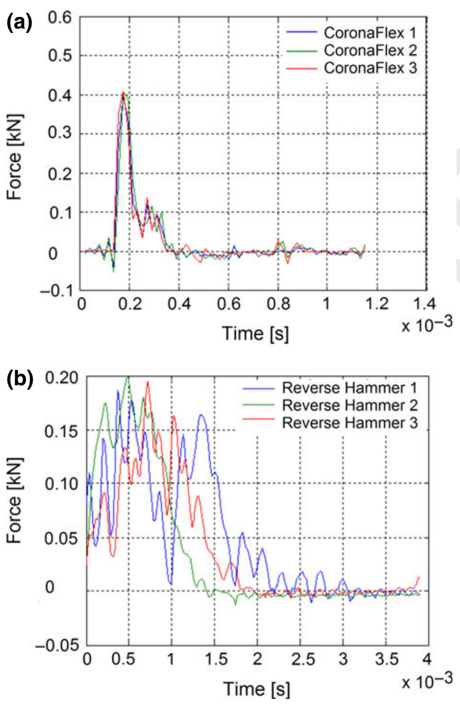

Fig. 7. Force pattern vs. time, produced by different experimental setups in the case of Coronaflex® tool (a) or reverse hammers (b).

Coronaflex® tool, replicating the experimental setup produces a percentage variation (standard deviation divided by the average value) equal to 8.8%, while, with reference to reverse hammer, the percentage variation has resulted to be much higher, reaching 37.5%. Figure 7 allows to visually evaluate the impact of replicating the experimental condition on the final signal shape.

***Table 3.* Average removal forces obtained for different Tool/Operator couples; numbers after the crown removal tool refer to replicated set ups**

	Coronaflex® 1 [N]	Coronaflex® 2 [N]	Coronaflex® 3 [N]
Operator 1	438.0	440.7	420.4
Operator 2	423.3	411.3	397.6
Operator 3	436.5	456.7	489.9
Operator 4	445.8	395.0	453.1
Operator 5	373.0	443.6	393.0
Operator 6	418.2	390.9	428.8
	Reverse hammer 1 [N]	Reverse hammer 2 [N]	Reverse hammer 3 [N]
Operator 1	120.4	123.7	112.3
Operator 2	176.6	186.7	279.2
Operator 3	118.1	197.9	99.3
Operator 4	186.9	184.9	186.3
Operator 5	163.1	316.0	296.9
Operator 6	197.7	243.2	242.5

Tool-operator and Experimental setup-operator interactions

The interactions between the tool and the operator and between the experimental setup and the operator are both significant (Table 2): certain operators have produced much more repeatable results in spite of using different tools or in different experimental setups, compared with other operators: see, for example, operator 5 with Coronaflex® or operator 4 with the reverse hammer (Table 1).

Discussion

The first result of this study is having set up an experimental procedure to simulate implant retrieval with different instruments. This setup allows the measurement of manually applied forces, and a more realistic estimation of forces applied by powered tools since the nominal impact force, declared by the producer (4 kN peak force for Coronaflex) refers to impacts against a stiff surface. When compliant elements are used, like the loop in this case, smaller forces are reached (489.9 N measured peak impact force, Table 3). This is even more true for the actual application where an additional compliance is given by deformable overdentures and their fixtures.

This experimental setup has been used in the present study to test the null hypothesis that there is no difference in forces produced by the Coronaflex® and the reverse hammer and to analyze their repeatability among different operators. Based on the statistical analysis of the results, the null hypothesis has been rejected: Coronaflex systematically produced larger impact forces, and lower force variability. It should be considered that a 10% variation can be considered a reasonable condition of work; in relation to this limit, Coronaflex® has certainly performed well: changing both the operator and the device, the peak removal force stays in the range from 373 N to 490 N (Table 3). On the contrary, the range of variation of the same peak force when using the reverse hammer is from 99 N to 316 N (Table 3).

The experimental setup here used has simplified real working conditions due to angular constraints: the forces were always directed along the vertical axis of the screw; in the clinical practice, it is not so frequent to apply the force in a direction perfectly parallel to the prosthetic axis, and, above all, to keep this angle constant. Secondly, the reverse hammer has been used working with one single full-stroke in order to allow its straightforward comparison to Coronaflex®; in the clinical practice, the operator usually performs a set of strokes, from different distances.

The pattern of force versus time is quite different between these two devices: Coronaflex® produces an impulsive force with a higher peak value and shorter duration compared with the reverse hammer; according to material engineering, impulsive forces are the most efficient to fracture fragile materials, while the input energy (that is the integral of force per speed) is more relevant for the rupture of ductile materials (Christensen 2005). At this stage, further experiments should be performed in order to establish which force is safer for the bone, the crown and the implant components (screw, abutment…).

The higher costs of the Coronaflex® when compared to the reverse hammer could be compensated by the possibility of performing easy and safe decementations of ceramic crowns (Sharma et al. 2012) using a more predictable device with specific tools.

The predictability and effectiveness of the Coronaflex® could address the clinician's choice toward the most appropriate cement to prevent intraoral decementation and to guarantee the retrievability of the crown related to the specific technical characteristics of this device. (Worni et al.2015).

Finally, it should be investigated which tool is more comfortable for the patient.

Within the limitation of our study, the following conclusions can be drawn:

- The use of Coronaflex® produces less variation between different operators.
- Coronaflex® produces a higher peak force and a shorter duration (sharper impulse).

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Conflict of interest

The authors declare no conflict of interest related to this study.

References

Akca, K., Iplicioglu, H. & Cehreli, M. (2002) Comparison of uniaxial resistance forces of cements used with implant supported crowns. *International Journal of Oral & Maxillofacial Implants* **17**: 536–542.

Assenza, B., Scarano, A., Leghissa, G., Carusi, G., Thams, U., Roman, F.S. & Piatelli, A. (2005) Screw- vs cement-implant-retained restorations: an experimental study in the beagle. Part I. Screw and abutment loosening. *Journal of oral Implantology* **31**: 242–246.

Breeding, L., Dixon, D., Bogacki, M. & Tiegte, J. (1992) Use of luting agents with an implant system: part I. *Journal of Prosthetic Dentistry* **68**: 737–741.

Bresciano, M., Schierano, G., Manzella, C., Screti, A., Bignardi, C. & Preti, G. (2005) Retention of luting agents on implant abutments of different height and taper. *Clinical Oral Implants Research* **16**: 594–598.

Chee, W., Felton, D., Johnson, P. & Sullivan, D. (1999) Current issue forum. Cemented versus screw-retained implant prostheses: which is better? *International Journal of Oral & Maxillofacial Implants* **14**: 137–141.

Chee, W., Torbati, A. & Albouy, P. (1998) Retrievable cemented implant restorations. *Journal of Prosthodontics* **7**: 120–125.

Chiche, G. & Pinault, A. (1991) Considerations for fabrication of implant supported posterior restorations. *International Journal of Prosthodontics* **4**: 37–44.

Christensen, R.M. (2005) Exploration of ductile, brittle failure characteristics through a two-parameter yield/failure criterion. *Materials Science & Engineering A* **394**: 417–424.

Guichet, D., Caputo, A., Choi, H. & Sorensen, J. (2000) Passivity of fit and marginal opening in screw-or-cement-retained implant fixed partial denture designs. *International Journal of Oral & Maxillofacial Implants* **15**: 239–245.

Hebel, K. & Gajjar, R. (1997) Cement-retained versus screw-retained implant restorations: achieving optimal occlusion and esthetics in implant dentistry. *Journal of Prosthetic Dentistry* **77**: 28–35.

Mehl, C., Harder, S., Schwarz, D., Steiner, M., Vollrath, O. & Kern, M. (2012a) *In vitro* influence of ultrasonic stress, removal force preload and thermocycling on the retrievability of implant-retained crowns. *Clinical Oral Implants Research*, **23**: 930–937.

Mehl, C., Harder, S., Shahriari, A., Steiner, M. & Kern, M. (2012b) Influence of abutment height and thermocycling on retrievability of cemented implant-supported crowns. *International Journal of Oral and Maxillofacial Implants* **27**: 1106–15.

Mehl, C., Harder, S., Steiner, M., Vollrath, O. & Kern, M. (2013) Influence of cement film thickness on the retention of implant-retained crowns. *Journal of Prosthodontics* **22**: 618–25.

Mehl, C., Harder, S., Wolfart, M., Kern, M. & Wolfart, S. (2008) Retrievability of implant-retained crowns following cementation. *Clinical Oral Implants Research* **19**: 304–1311.

Sharma, A., Rahul, G.R., Poduval, S.T. & Shetty, K. (2012) Removal of failed crown and bridge. *Journal of Clinical and Experimental Dentistry* **4**: 167–72.

Taylor, T., Agar, J. & Vogiatzi, T. (2000) Implant prosthodontics: current perspective and future directions. *International Journal of Oral & Maxillofacial Implants* **15**: 66–75.

Torrado, E., Ercoli, C., Al Mardini, M., Graser, G.N., Tallents, R.H. & Cordaro, L. (2004) A comparison of the porcelain fracture resistance of screw-retained and cement-retained implant-supported metal-ceramic crowns. *The Journal of Prosthetic Dentistry* **9**: 532–7.

Worni, A., Gholami, H., Marchand, L., Katsoulis, J., Mericske-Stern, R. & Enkling, N. (2015) Retrievability of implant-supported crowns when using three different cements: a controlled clinical trial. *The International Journal of Prosthodontics*, **28**: 22–29.

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