A rationale for retrievability of fixed, implant-supported prostheses: a complication-based analysis.

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Abstract

PURPOSE: This article presents a rationale for retrievability of fixed, implant-supported prostheses based on the incidence and variety of biologic and technical complications. The etiologies of these complications are also discussed, emphasizing the unpredictability of implant-based prostheses in the oral environment.

MATERIALS AND METHODS: Electronic searches of the MEDLINE (Ovid) database were initially conducted to find articles in English relating to the incidences and/or etiologies of dental implant complications up to May 2006. These articles were then manually searched and potential papers investigated. Electronic and manual searches of 11 peer-reviewed dental journals completed the research strategy, with a hierarchy of evidence-based information established to support this complication-based analysis.

RESULTS: Biologic and technical complications appear to be common in all forms of fixed implant-supported dentistry. These complications often jeopardize the functional and/or esthetic features of a given prosthesis, and they occur despite sound prosthetic design and high levels of clinical expertise. Observational studies and systematic reviews dominate this area of the dental literature, leaving the clinician to individually assess the merits of prosthetic retrievability based only on the likelihood of complications and the costs of replacing a permanently cemented prosthesis. These assessments challenge the philosophy of permanent cementation, but there is a need for better, evidence-based information to properly evaluate the costs of prosthetic retrievability against the obvious clinical benefits.

CONCLUSION: The practice of permanently cementing implant-based prostheses may conflict with the likelihood of biologic and technical failure. The retrievability of fixed, implant-supported prostheses is therefore an important consideration in delivering quality, patient-based treatment outcomes.

The effects of abutment taper, length and cement type on resistance to dislodgement of cement-retained, implant-supported restorations.

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Abstract

PURPOSE: The purpose of this study was to compare the effect of 20 degrees and 30 degrees of total occlusal convergence (TOC), the occlusocervical dimension, and the type of cement on the tensile resistance to dislodgement of cement-retained, implant-supported restorations.

MATERIALS AND METHODS: Cylindrical preparations with TOC angles of 20 degrees and 30 degrees and occlusocervical dimensions of 4 mm (S) and 8 mm (L) were made through a machining process. The cylinders had a shoulder finish line of 1.0 mm in depth. Eight impressions were made of each machined cylinder and poured in type IV dental stone, for a total of 32 dies. Die spacer was applied to each die. A master wax pattern was designed, and the 32 wax patterns were marginated, invested, and cast in type IV gold alloy (n = 8). The gold crowns were cemented with Fleck's cement (zinc phosphate cement), Temp-Bond (zinc oxide eugenol cement), Temp-Bond plus Vaseline (30% by weight), and IMProv temporary cement (acrylic/urethane cement) under a 10-kg load and placed in a humidor at 37 degrees C for 1 hour before testing. A uniaxial tensile force was applied to the crown using an Instron machine with a crosshead speed of 5 mm/min until cement failure occurred. Analysis of variance models were fit to determine the effect of TOC, occlusocervical dimension, and cement type of the restorations on the mean tensile strength.

RESULTS: For each type of cement, the mean tensile strengths were significantly higher at 20 degrees of TOC and 8 mm of occlusocervical dimension compared with the other preparations. At this preparation, IMProv had the highest mean tensile resistance to dislodgement (47.7 +/- 8.4 kg), followed by Fleck's (38.2 +/- 8.8 kg), Temp-Bond (35.9 +/- 4.4 kg), and Temp-Bond plus Vaseline (8.2 +/- 2.2 kg). No statistically significant difference was observed between Temp-Bond and Fleck's zinc phosphate cement when 20 degrees of TOC and 8 mm of occlusocervical dimension was used. There was no statistical difference in the mean tensile resistance to dislodgement for Temp-Bond plus Vaseline with different preparation designs (p > 0.05) except when 20 degrees of TOC and 8 mm of occlusocervical dimension was used. The mean tensile strength was significantly different between Temp-Bond and Temp-Bond plus Vaseline for each of the 4 preparation designs (p < 0.05). Among the cements tested, IMProv exhibited higher values, which were statistically different (p < 0.05). Restorations with greater occlusocervical dimension and less TOC exhibited higher tensile resistance to dislodgement.

CONCLUSIONS: Preparations with 20 degrees of TOC and 8 mm of occlusocervical dimension had significantly higher mean retentive values for all of the cements tested. Significant differences in mean tensile strength were observed, with the highest tensile resistance seen with IMProv, followed by Fleck's cement, and the lowest tensile resistance seen with Temp-Bond plus Vaseline.
The effect of luting agents on the retention of dental implant-supported crowns.

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Abstract

BACKGROUND: This study was designed to evaluate the retentive strength of 7 different luting agents on cement-retained implant abutment/analog assemblies.

METHODS: Fifty-six Steri-Oss implant abutment/analog assemblies and cast superstructures were randomly divided into 7 groups: definitive cements included zinc phosphate cement, Advance, All-Bond 2, Panavia F, and Durelon, while provisional cements included Temp Bond and ImProv. After the superstructures were cemented onto the implant abutments, the specimens were subjected to 100,000 cycles on a chewing machine (75 N) and 1000 cycles on a thermocycling machine (0-55 degrees C). A universal testing machine was used to test the cement failure load values for each specimen. One-way ANOVA and Duncan's multiple-range analysis were used to determine the effects of luting agents on cement failure load values.

RESULTS: The following values for the mean and standard deviation of cement failure loads for each group were obtained: zinc phosphate, 1.225 +/- 0.229 MPa; Advance, 1.205 +/- 0.197 MPa; All Bond 2, 1.752 +/- 0.211 MPa; Panavia F, 1.679 +/- 0.176 MPa; Durelon, 0.535 +/- 0.161 MPa; Temp Bond, 0.274 +/- 0.079 MPa; and ImProv, 0.319 +/- 0.107 MPa.

CONCLUSIONS: There were significant differences in cement failure loads among the various cements tested. Values significantly differed among 4 groups consisting of All-Bond 2 and Panavia F resin cements, zinc phosphate cement and Advance hybrid ionomer cement, Durelon carboxylate cement, and ImProv and Temp Bond provisional cements (p < 0.0001). All-Bond 2 and Panavia F resin cements had statistically significantly higher values for cement failure loads compared to the other 5 types of cement.

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Comparison of 7 luting protocols and their effect on the retention and marginal leakage of a cement-retained dental implant restoration.


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PURPOSE: To determine the cement bond strength and marginal leakage of castings cemented to implant abutments.

MATERIALS AND METHODS: Fifty-six titanium abutments and castings were divided into 7 groups (n=8), 1 for each cement. Castings were cemented to abutments using 1 of 3 resin-based cements (RES, RES-B, and RES-B-P), a resin-modified glass ionomer (GI), a polycarboxylate cement (PCB), an acrylic urethane cement (UDM), or a zinc phosphate cement (ZP). Specimens were placed in 100% humidity at 37 degrees C for 24 hours. Specimens were subjected to compressive load cycling followed by thermal cycling; they were then immersed for 24 hours in 0.5% basic fuchsin. Castings were removed with an Instron universal testing machine with a crosshead speed of 0.125 cm/min. Leakage was visually graded from 0 (no leakage) to 2 (leakage extended beyond the lower half of the internal surface of the casting). Failure load (FL) was analyzed with analysis of variance and Scheffe's test (alpha = .05). Chi-square was used to analyze leakage (alpha = .05).

RESULTS: Cements were categorized by FL into 4 statistically unique groups: (1) RES-B-P (351 N) and GI (337 N); (2) ZP (245 N) and RES-B (241 N); (3) PCB (107 N); and (4) RES (63 N) and UDM (55 N). Leakage was greater for the PCB group than for the other groups (7 of 8 specimens demonstrated leakage; P < .01). Three ZP specimens demonstrated leakage. UDM and RES each had 1 specimen with leakage. RES-B-P, RES-B, and GI showed no leakage.

CONCLUSIONS: Luting agents designated by the manufacturer as provisional cements demonstrated lower resistance to removal, regardless of material type. Luting agents described by manufacturers as "permanent" differed in resistance, with resin cements being most resistant, followed by zinc phosphate and polycarboxylate cements. Provisional cements demonstrated leakage comparable to higher-strength materials.

Retention and leakage of implant-supported restorations luted with provisional cement: a pilot study.

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Abstract

Few data exist regarding cement failure load and marginal leakage of castings cemented to implant-supported abutments subjected to load and thermal cycling, especially with newer cements. This study evaluated the cement failure load and marginal leakage of castings cemented to Steri-Oss abutment/analog assemblies with one of seven luting protocols (n = 5). Protocols consisted of a zinc phosphate control, zinc phosphate with petroleum jelly, TempBond, TempBond NE, ImProv, ImProv with petroleum jelly and Provilink. Cemented castings were subjected to cyclic axial compression of 75 N for 100,000 cycles, 1000 thermal cycles (5-55 degrees C), and immersed 24 h in 0.5% basic fuchsin. The castings were then
loaded in tension until cement failure. Cement failure load was analysed using anova and Fischer's PLSD (alpha = 0.05). Marginal leakage on the intaglio of the casting was scored with the unaided eye on a scale of 0-2, and analysed with Duncan's multiple range (alpha = 0.05). Similar groups are noted by superscript. Cement failure load (from lowest to highest): ImProv with petroleum jelly(a), TempBond(a), ImProv(a), Tempbond NE(a), Provilink(a), zinc phosphate with petroleum jelly(b), zinc phosphate(c) (P < 0.0001). Marginal leakage scores (from lowest to highest): ImProv(a), Provilink(a), ImProv with petroleum jelly(a), zinc phosphate(ab), zinc phosphate with petroleum jelly(ab), TempBond(bc), and TempBond NE(c) (P = 0.01). Addition of petroleum jelly to zinc phosphate lowered cement failure load without affecting marginal leakage. ImProv and Provilink demonstrated relatively low cement failure load, as well as lowest marginal leakage.

The effect of thermal cycling and air abrasion on cement failure loads of 4 provisional luting agents used for the cementation of implant-supported fixed partial dentures.

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Abstract

PURPOSE: To investigate the effects of thermal cycling and surface roughness of metal implant abutments and the intaglio surface of the copings on the retentive properties of 4 provisional luting agents commonly used in the cementation of implant-retained fixed partial dentures (FPDs).

MATERIALS AND METHODS: A 2-unit implant-retained FPD and a 4-unit implant-retained FPD were fabricated using gold-palladium alloy. The abutments used were 5 mm in height. The FPDs were cemented with 4 commonly used provisional luting agents and thermocycled for 700 cycles from 5 degrees C to 36 degrees C to 55 degrees C and were then subjected to tensile strength testing. After thermal cycling, the intaglio surfaces of the same FPDs and the abutments were air-abraded with 50 microm Al2O3 particles. FPDs were cemented using the same provisional cements, and after 24 hours of storage in 100% humidity, tensile strength tests were performed. Descriptive statistics, 2-way analysis of variance, Friedman's 2-way ANOVA, and Tukey's HSD test (alpha = .05) were performed.

RESULTS: Both thermal cycling and air abrasion had a significant effect (P < .001) on the retentive values of all cements tested. A noneugenol provisional cement (Nogenol) exhibited the lowest mean retentive value after both thermal cycling and air abrasion for both the 2- and 4-unit FPD models. The urethane resin provisional cement (Improv) exhibited the highest mean retentive strength for both the 2- and 4-unit FPDs after thermal cycling and air abrasion treatments.

CONCLUSIONS: Thermal cycling had a detrimental effect on the retentive properties of all cements tested. Air abrasion significantly improved the cement failure loads of the
provisional luting agents used in the study and seems to be an effective way of increasing the retention of implant-retained FPDs.

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**Survey of United States dental schools on cementation protocols for implant crown restorations.**

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Abstract

**STATEMENT OF PROBLEM:** With conflicting results in the literature and various manufacturer recommendations, it is not known what cementation protocols are currently being used for implant restorations in US dental schools.

**PURPOSE:** The purpose of this survey was to determine what dental cementation protocols are taught and recommended by 62 US dental schools and postgraduate programs.

**MATERIAL AND METHODS:** From February to September 2008, 96 questionnaires consisting of 8 questions were sent to the chairperson or director of restorative departments, advanced prosthodontics programs, and implant programs. The questionnaire asked recipients which implant manufacturers provided the products used at their dental schools. Additionally, recipients were queried as to the choice of material and techniques for abutment and restoration preparations prior to definitive cementation. Data were analyzed with descriptive statistics.

**RESULTS:** A total of 68 (71%) surveys were returned, and 52 (84%) of the 62 predoctoral and postgraduate programs were represented. After deleting duplicate responses, 31 surveys were returned from restorative department chairpersons, 29 from advanced prosthodontic program directors, and 2 from implant program directors. Frequency of responses to each question was tabulated, and results are presented in 3 sections. For all 3 types of programs, Nobel Biocare was reported to be the most widely used implant system, followed by Biomet 3i, Straumann, Astra Tech, and Zimmer Dental systems. The most commonly used technique prior to definitive cementation is to airborne-particle abrade the intaglio surface of the restoration. Resin-modified glass ionomer is the most frequently used luting agent for cementing implant restorations. The 5 most commonly used materials to fill screw access openings are cotton pellets, composite resin, rubber-based material, gutta-percha, and light-polymerized provisional composite resin. Most predoctoral and postgraduate programs teach students to fill the screw access opening completely to the occlusal surface.

**CONCLUSIONS:** There are a wide range of implant cementation protocols and materials used; however, some common trends were identified among predoctoral and postgraduate programs.
Comparative evaluation of casting retention using the ITI solid abutment with six cements.

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Abstract

OBJECTIVE: The purpose of this study was to test the retention of metal copings fabricated to fit on the one-groove, one flat-sided solid titanium abutment using six different cements.

MATERIALS AND METHODS: Ten hollow screw 3.8 mm ITI implants were mounted in acrylic resin blocks. A solid titanium abutment was placed on each implant and torqued at 35 Ncm. Prefabricated burn-out caps were placed on the titanium abutment and wax loops added to the occlusal surface to allow for subsequent retention testing. All plastic caps were embedded in phosphate-bonded investment and cast with noble alloy. Castings were inspected for surface irregularities using a stereomicroscope at 10x magnification. The six cements were: 1) eugenol-free zinc oxide (Temp Bond NE); 2) zinc-oxide eugenol (IRM); 3) zinc phosphate (Hy-Bond); 4) resin-modified glass ionomer (Protec Cem); 5) zinc polycarboxylate (Durelon) and 6) 10-methacryloyloxydecyldihydrogen phosphate resin (Panavia 21). After cementation, implant-abutment-casting assemblies were stored for 24 h in 100% humidity. Samples were subjected to a pull-out test using an Instron universal testing machine at a crosshead speed of 0.5 mm/min. The load required to de-cement each coping was recorded and mean values for each group calculated. Means and standard deviations of loads at failure were analyzed using ANOVA and a Tukey studentized test. Statistical significance was set at P < or = 0.05.

RESULTS: The mean values (+/- SD) of loads in kilograms at failure (n = 10) for the various cements were as follows: Temp Bond 3.18 (+/- 1.1) (Tukey group D), IRM 9.25 (+/- 3.83) (Tukey group CD), HY-Bond 10.9 (+/- 6.52) (Tukey group C), Protec Cem 18.98 (+/- 6.23) (Tukey group B), Durelon 23.55 (+/- 4.29) (Tukey group B) and Panavia 21, 36.53 (+/- 8.1) (Tukey group A). Means with the same letter in the Tukey grouping are not significantly different.

CONCLUSIONS: The retention values of castings cemented to ITI solid abutments have not been reported in the literature. Within the limitations of this in vitro study, the results do not suggest that one cement type is better than another, but they do provide a ranking order of the cements in their ability to retain the castings. This ranking is somehow different than that obtained when the same cements are used on natural teeth. The material and surface characteristics of the implant abutment are likely responsible for this difference. Cement retention values obtained from studies that use teeth as abutments may be misleading when used in cement-retained implant-supported crowns. It is at the clinician's discretion to use a certain type of cement, based on the situation at hand.
**Retentiveness of dental cements used with metallic implant components.**
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**Abstract**

There is limited dental literature evaluating the retentive capabilities of luting agents when used between metal components, such as cast metal restorations cemented onto machined metal implant abutments. This study compared the retentive strengths of 5 different classes of luting agents used to cement cast noble metal alloy crowns to 8-degree machined titanium cementable implant abutments from the Straumann ITI Implant System. Sixty prefabricated 5.5-mm solid titanium implant abutments and implants were used; 30 received the standard surface preparation and the other 30 received an anodized surface preparation. Anodized implant components were used to reflect current implant marketing. Sixty castings were fabricated and randomly paired with an abutment and implant. A total of 12 castings were cemented onto the implant-abutment assemblies for each of the 5 different luting agents (zinc phosphate, resin composite, glass ionomer, resin-reinforced glass ionomer, and zinc oxide-non-eugenol). After cementation, the assemblies were stored in a humidor at room temperature prior to thermocycling for 24 hours. Each casting was pulled from its respective abutment, and the force at which bond failure occurred was recorded as retentive strength. A statistically significant difference was found between the 5 cements at P ≤ .001. Of the cements used, resin composite demonstrated the highest mean retentive strength. Zinc phosphate and resin-reinforced glass-ionomer cements were the next most retentive, while glass ionomer and zinc oxide-non-eugenol cements demonstrated minimal retention. In addition, retention was not altered by the use of an anodized abutment surface.

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**Corrosion at the marginal gap of implant-supported suprastructures and implant failure.**
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**Abstract**

PURPOSE: Late failure, which occurs after successful osseointegration, is usually attributed to prosthodontic determinants. Corrosion of metallic suprastructures and incorrectly handled materials are often primary causes of late implant failure. In this study, 6 implants whose failure was related to suprastructure metal corrosion and adjacent bone were investigated.
MATERIALS AND METHODS: Six implants as well as their suprastructures were analyzed for surface corrosion using light and scanning microscopy. Metal alloys and soldering compounds were analyzed using energy-dispersive x-ray analysis. Bone adhering to the implants was removed and analyzed for metal content using atom absorption spectroscopy.

RESULTS: Extensive corrosion lesions and areas of oxidation were detected on all 6 of the implants and inner crown surfaces. Bone tissue collected from 5 of the implants showed higher contents of metal ions in comparison to physiologic baseline values detected in healthy bone.

DISCUSSION: In spite of the high gold content of the suprastructure, corrosion occurred. Bonding oxides necessary for the process of fusing porcelain to gold will initiate corrosion. Apparently, once corrosion is initiated it rapidly progresses at the gap crevices, and toxic metal ions are released. These toxic ions diffuse into the peri-implant bone, causing bone structure breakdown and hastening osseodisintegration.

CONCLUSION: Biocompatible metals, alloys, and ceramics should be used for implant-supported suprastructures. It is also essential that gaps between the implant and its suprastructure be avoided by cementing the suprastructure or sealing the gap.