An Invitro Study to Evaluate and Compare the Effect of Surface Treatment of Implant Abutments on the Retentivenesss of Three Commercially Available Provisional Cements

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Abstract

There is no universal opinion regarding the cement selection for implant supported prosthesis. Retentive potential of cements on a smooth abutment head is questionable. Surface modifications of abutments by sandblasting may increase the retentive strength of cemented castings as a result of micro and macro-retention.

The present study was carried out to evaluate and compare the cement failure load of an implant supported restoration when used on abutments of varying texture with various provisional cements.

Ten implant analogs and thirty implant abutments were used. Copings were seated on abutment with hand pressure for 10 seconds. This was followed by placement of a 5 kg load with help of cementation jig. Universal testing machine was used to test the cement failure load of the luting cements. Abutments were sandblasted with 50 µm aluminum oxide particles. New groups of copings were checked for internal surface configuration, passivity, and marginal adaptation on implant abutment-analog assembly before cementation and all the test specimens were stored in saline for 24 hours after cementation. Subsequently, all the test specimens were subjected for testing.

The results of the study showed that, the maximum cement failure load value (113.79 N) was observed in sandblasted abutments with RelyXTM Temp NE cement. The least cement failure load value (63.76 N) was observed in non-sandblasted abutments with FREEGENOL TEMPORARY PACK cement.

Sandblasting with 50 µm aluminium oxide particles for 5 seconds at a distance of 10 mm increased the cement failure load value in all the cement groups.

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Introduction

The long-term criteria for successful dental implants have been previously based on osseointegration status.[1,2,3] However, more recently the quest for predictable long-term results has raised several questions concerning the materials used as well as the techniques followed in clinical practice. One of these questions concerns the type of connection between the prosthesis and the implant.[4,5]

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Fixed implant supported prostheses can be screw-retained or cement retained. Screw-retained prostheses have a well-documented history of successful application in completely edentulous patients. However, with the increase in number of partially edentulous patients, new concepts have evolved in the field of implant prosthodontics, including cement-retained prostheses.[6]

Screw-retained, implant-supported prostheses were developed in response to the need for retrievability of prostheses.[7,8] Retrievability of the prosthesis is necessitated by screw loosening, fracture of fastening screws, fracture of abutments, modification of the prosthesis after loss of an implant in case of multiple implant restoration, and surgical reintervention. It should also be noted that removal of implant-supported fixed partial denture is sometimes needed for better evaluation of oral hygiene. Peri-implant probing will be more accurate if the prosthesis is removed. However, screw-retained prostheses are also associated with non-passive superstructures, partially unretained prostheses resulting from loosening or breakage of fastening screws, rapid loading of the implant interface and compromised esthetics because of screw access hole.[9,10]

Cement retention has been used in conventional fixed prosthodontics for almost 100 years, and a significant and well-documented history has developed out of its use. This extensive knowledge base is also applied to implant dentistry.[11]

Several arguments, both for and against these two possible ways of fixing the prosthesis to the implant abutment can be found. However, there is no consensus on whether one method is superior to the other, but cemented prosthesis seems to be gaining more popularity because of a lower complication rate and a higher fracture resistance of the veneering ceramic. However there is no universal opinion regarding the cement selection for implant supported prosthesis.[12]

This conundrum naturally focuses attention on the choice of cement. On one hand, selection of a cement that is too retentive could lead to damage of prosthesis or implant and its abutment due to aggressive removal techniques, whereas on the other hand, selection of a cement that is not retentive enough could be a potential source of embarrassment for the patient. As a result, practitioners who desire retrievability have generally gravitated towards using cements with sub-maximal retentive properties.[13]

In cemented restorations it is necessary to use semi-permanent or provisional cements to facilitate retrieval for a successful implant restoration. But retentive potential of cements on a smooth abutment head is questionable. Surface modifications of abutments by sandblasting may increase the retentive strength of cemented castings as a result of micro- and macroretention.[14] Inspite of plethora of commercially available zinc oxide non eugenol cements, not many studies have been done on the retentiveness of variety of non-eugenol cements to surface treated abutments. Therefore, the present study is being carried out to evaluate and compare the cement failure load of an implant supported restoration when used on abutments of varying texture with various provisional cements.

Materials and methods

Materials and Armamentarium Used

Materials

1. Titanium abutments for implants of diameter 4.2mm (Mirell dental implant systems, Amsterdam, Netherlands)
2. Prefabricated plastic copings of diameter 4.2mm (Mirell dental implant systems, Amsterdam, Netherlands)
3. Implant analogs for Implants of Diameter 4.2mm (Mirell dental implant systems, Amsterdam, Netherlands)
4. Hex drive (Nobel Biocare, Goteborg, Sweden)
5. Torque wrench (Nobel Biocare, Goteborg, Sweden)
6. Casting wax (Hindustan inlay wax, India)
7. Phosphate bonded investment material (Bellavest SH, BEGO, Germany)
8. Ni-Cr alloy (Bellabond plus, BEGO, Germany)
9. Aluminium oxide blasting material-50µm (korox 50 , BEGO, Germany)
10. Zinc oxide non eugenol temporary cements (RelyXTMTemp NE, OraTemp NE, FREEGENOL TEMPORARY PACK)
11. Universal Implant Scaler (IMPHDL 6, Usa)
12. Normal saline (SODIUM CHLORIDE INJECTION IP, Claris life sciences Ltd, India)

Armamentarium

1. Surveyor (MARATHON-103, Germany)
2. Metal thickness measuring calipers
3. Ring for investing wax patterns
4. Vaccum mixing machine (AX-2000 vaccum mixer, Germany)
5. Burn-out furnace (INFIRE, Sirio, Italy)
6. Induction casting machine (Fornax, BEGO, Germany)
7. Sand blaster (KOROSTAR Z, BEGO, Germany)
8. Steam jet (TISSI Dental, Italy)
9. Stereomicroscope (Mobiloskop, Renfert, Usa)
10. Custom cementation jig.
11. Universal testing machine (UTE Series 9302, India)

Methodology

The present in-vitro study was carried out to evaluate and compare the cement failure load of an implant supported restoration when used on abutments of varying texture (non sandblasted and sandblasted) with three commercially available zinc oxide non eugenol provisional cements (RelyX^{TM}Temp NE, OraTemp NE, FREEGENOL TEMPORARY PACK). The study comprised of 60 specimens of implant abutments and copings divided into 6 groups, each group containd 10 specimens.

Different groups for cement failure load testing were categorized as follows

- Group I-Copings cemented on non sandblasted abutments with cement A (RelyX^{TM}Temp NE)
- Group II- Copings cemented on sandblasted abutments with cement A (RelyX^{TM}Temp NE)
- Group III-Copings cemented on non sandblasted abutments with cement B (OraTemp NE)
- Group IV-Copings cemented on sandblasted abutments with cement B (OraTemp NE)
- Group V- Copings cemented on non sandblasted abutments with cement C (FREEGENOL TEMPORARY PACK)
- Group VI-Copings cemented on sandblasted abutments with cement C (FREEGENOL TEMPORARY PACK)

Ten implant analogs (color plate-1) and thirty implant abutments (color plate-2) were used. Ten implant analogs were mounted in individual auto-polymerizing acrylic resin blocks (2.9cm X 1.4cm X 1.4cm) (color plate-3) using dental surveyor. Titanium abutments were fixed on each implant analog using hex drive and torqued at 35 Ncm using a torque wrench. A wax loop was attached on the occlusal aspect of each prefabricated plastic coping (color plate-4). The loop helps in attaching the assembly (metal coping, abutment, implant analog and acrylic resin block) to the universal testing machine (color plate-5) with the help of a custom made hook (color plate-6).

Plastic copings with attached loops were invested using phosphate bonded investment material. Subsequently the invested cylinders were kept for burnout (color plate-7). Casting was done using Ni-Cr alloy in an induction casting machine (color plate-8). Copings were divested, and finishing and polishing was done. Each metal coping was examined under magnification using Stereo microscope (color plate-9) for surface irregularities on the intaglio surface. Then intaglio surfaces of all the metal copings and the abutments surfaces were steam cleaned (color plate-10) to remove residual investment material. All the specimens were air dried and visually inspected for surface cleanliness. Metal copings were seated on abutments to evaluate marginal fit and complete seating of the copings on abutments. Abutment screw access was filled with modeling wax to prevent the cement escape into internal abutment cavity so as to force the cement into micromechanical irregularities of the intaglio surface of metal copings under pressure.

The same person mixed all luting cements at room temperature on a mixing paper pad and plastic spatula. Materials were mixed in accordance with the protocol [(RelyX^{TM}Temp NE: equal lengths of baste paste and catalyst paste; mixing time: 30 seconds; setting time: 3.30 minutes), (OraTemp NE: equal lengths of base paste and catalyst paste; mixing time: 30 seconds; setting time: 3 minutes), (FREEGENOL TEMPORARY PACK: equal lengths of base paste and catalyst paste; mixing time: 25 seconds; setting time: 3 minutes) (color plate-11)] which were set forth by manufacturers. Cements were applied on axial surface of the copings with a brush (color plate-12) to avoid excess cement so that hydrostatic pressure will be minimized during seating. Copings were seated quickly on abutment with hand pressure for 10 seconds. This was followed immediately by placement of a 5 kg load with help of cementation jig (color plate-13) directed down the long axis maintained for 10min. Specimens were examined visually to confirm complete seating of the coping onto the abutment, referenced by the absence of marginal space. Then implant analog-abutment-coping assemblies were stored in saline solution for 24 hrs.

Universal testing machine was used to test the cement failure load of the luting cements. Acrylic blocks were attached with lower tensile jig of universal testing machine. Care was taken to align the acrylic block vertically and parallel to the forces in order to avoid any rotational components. Vertical loops of the copings were attached to the upper tensile jig of universal testing machine with the help of a custom made hook. Tensile load was applied at a constant crosshead speed of 0.5mm/min until separation of the copings occurred. The loads at failure were recorded in Newton.

Abutment surfaces were steam cleaned to remove the residual cement. Whenever necessary, remaining cement on abutment surfaces was removed with Universal Implant Scaler (color plate-14). Abutments were sandblasted with 50 µm aluminum oxide particles for 5 seconds at a distance of 10 mm (color plate-15) to attain next groups (groups II, IV and VI) of abutments. A curved probe was used to remove the residual cement from the intaglio surface of copings. After that, all copings were air abraded with 50 µm aluminum oxide particles for 5 seconds to assure the cleanliness. New groups of copings were checked for internal surface configuration, passivity, and marginal adaptation on implant abutment-analog assembly before cementation and all the test specimens were stored in saline for 24 hours after cementation. Subsequently, all the test specimens were subjected for testing.

Results

Results were analyzed using one way ANOVA to identify statistically significant difference in cement failure load among the cement groups. Tukey's post hoc test was conducted to know which group showed significant difference. The effect of sand blasting on each cement groups were identified by paired t-test.

Figure 1. Implant analogs. (Mirell dental implant systems, Amsterdam, Netherlands).

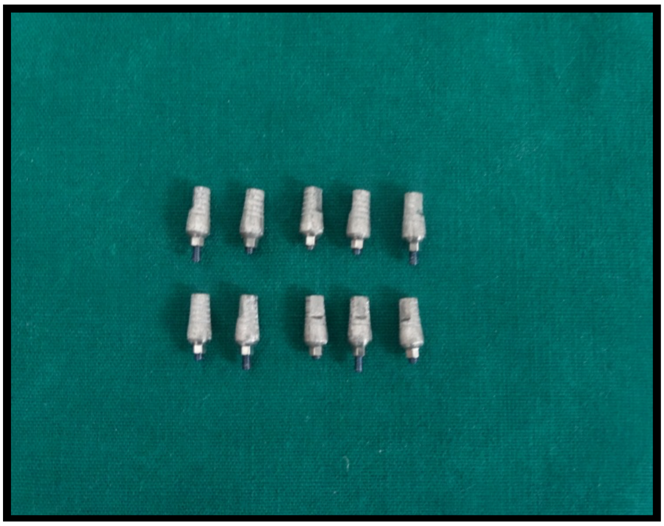


Figure 2. Implant analogs. (Mirell dental implant systems, Amsterdam, Netherlands).

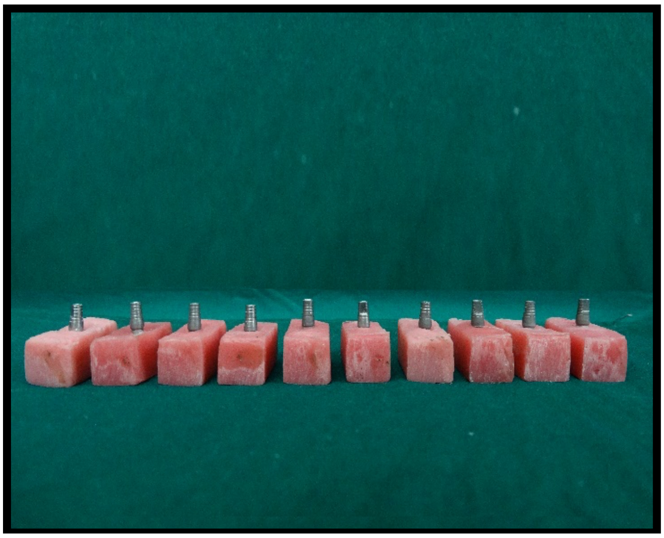


Figure 3. Implant analogs mounted in individual. auto-polymerizing acrylic resin blocks.

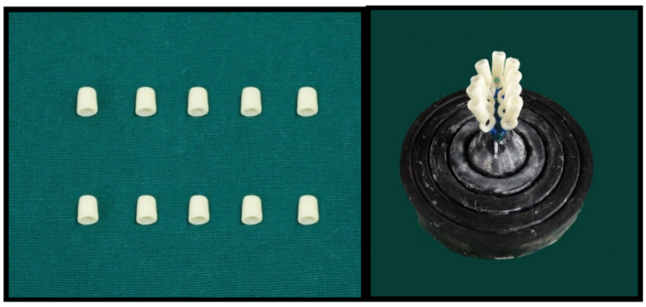


Figure 4. Plastic copings. (Mirell dental implant systems, Amsterdam, Netherlands).

Figure 5. Universal testing machine (UTE Series 9302, India).

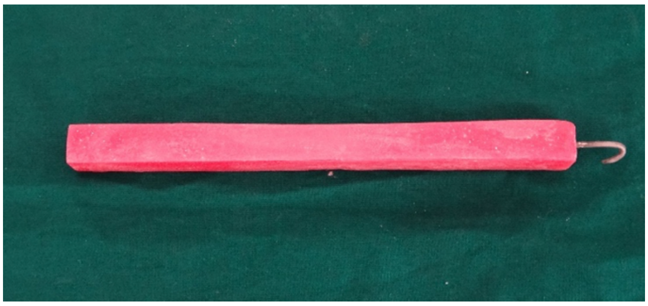


Figure 6. Custom made hook.

Figure 7. Burn-out furnace (INFIRE, Sirio, Italy).

Figure 8. Induction casting machine (Fornax, BEGO, Germany).

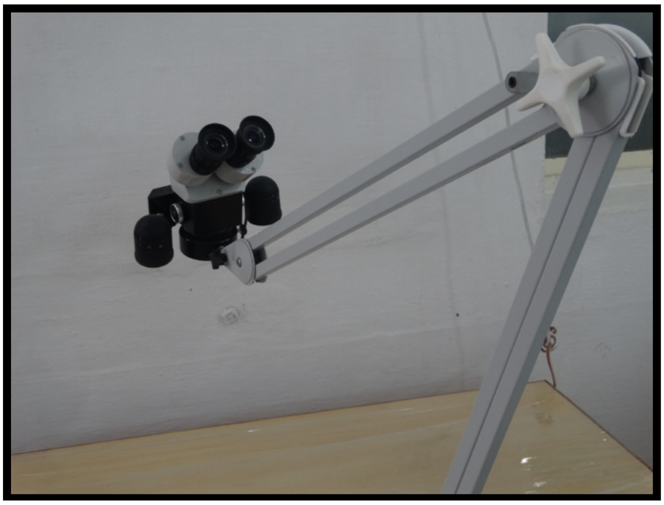


Figure 9. Stereo microscope (Mobiloskop, Renfert, Usa).

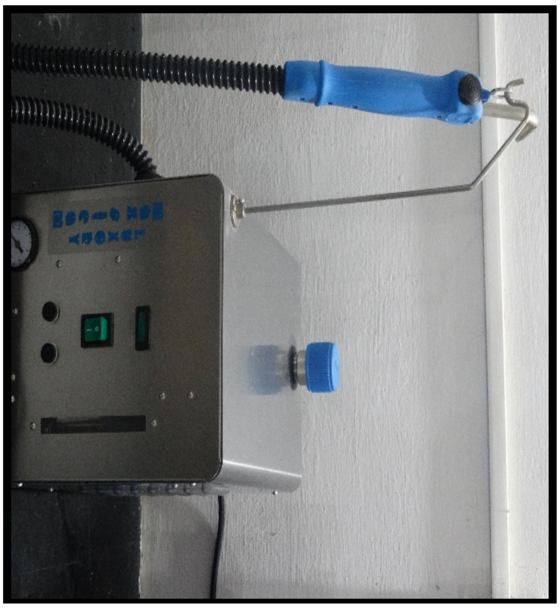


Figure 10. Steam jet (TISSI Dental, Italy).

Figure 11. Zinc oxide non eugenol temporary cements. (RelyX^{TM} Temp NE, OraTemp NE, FREEGENOL TEMPORARY PACK)

Figure 12. Brush used to apply cement on axial surface of copings.

Figure 13. Custom cementation jig.

Figure 14. Universal Implant Scaler (IMPHDL 6, Usa).

Figure 15. Sand blaster (KOROSTAR Z, BEGO, Germany).

Specimen No.	Group I	Group II	Group III	Group IV	Group V	Group VI
1.	88.29	117.72	78.48	117.72	78.48	78.48
2.	88.29	127.53	88.29	107.91	49.05	107.91
3.	78.48	107.91	78.48	98.1	58.86	78.48
4.	98.1	107.91	68.67	107.91	49.05	88.29
5.	68.67	98.1	88.29	98.1	58.86	98.1
6.	88.29	117.72	68.67	117.72	68.67	78.48
7.	68.67	107.91	78.48	117.72	78.48	98.1
8.	88.29	127.53	88.29	117.72	68.67	107.91
9.	68.67	107.91	78.48	107.91	58.86	98.1
10.	78.48	117.72	78.48	98.1	68.67	78.48

Table 1. The cement failure load (tensile load) of each test specimen. (NEWTON).

Where;

- Group I - Copings cemented on non-sandblasted abutments with cement A (RelyX™ Temp NE)
- Group II - Copings cemented on sandblasted abutments with cement A (RelyX™ Temp NE)
- Group III - Copings cemented on non-sandblasted abutments with cement B (OraTemp NE)
- Group IV - Copings cemented on sandblasted abutments with cement B (OraTemp NE)
- Group V - Copings cemented on non-sandblasted abutments with cement C (FREEGENOL TEMPORARY PACK)
- Group VI - Copings cemented on sandblasted abutments with cement C (FREEGENOL TEMPORARY PACK)

Statistical Analysis

Cement	A		B		C	
	Mean	Sd	Mean	Sd	Mean	Sd
Non sandblasted	Group I 81.4230	10.3922	Group III 79.4610	7.2385	Group V 63.7650	10.5960
Sandblasted	Group II 113.7960	9.4774	Group IV 108.8910	8.5896	Group VI 91.2330	12.2788

Table 2. Descriptive statistics comparison of three non-eugenol temporary cements between non sandblasted and sandblasted groups

where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.

Variable	t-value	df	p-value
Nonsandblasted & Sandblasted	-11	9	1.61e-06

Table 3. Results of paired t-test of cement A (RelyXTM Temp NE cement) for non sandblasted and sandblasted groups.

Variable	t-value	df	p-value
untreated & treated	-7.6064	9	3.305e-05

Table 4. Results of paired t-test of cement B (OraTemp NE cement) for non sandblasted and sandblasted groups.

Variable	t-value	df	p-value
untreated & treated	-4.7254	9	0.001081

Table 5. Results of paired t-test of cement C (FREEGENOL TEMPORARY PACK cement) for non-sandblasted and sandblasted groups.

Source of variation	df	sum of squares	mean sum of squares	F-value	p-value
Cement	2	1873	936.7	10.31	0.000472
Residuals	27	2454	90.9		

Table 6. Results of one way analysis of variance among cement A, B and C when used with non sandblasted groups (Group I, Group III and Group V).

	B	C
A	0.8903	0.0009
B		0.0028

Table 7. Results of Tukey's post hoc test between cement A - cement B, CEMENT A - cement C, and cement B - cement C when used with non sandblasted groups.

where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.

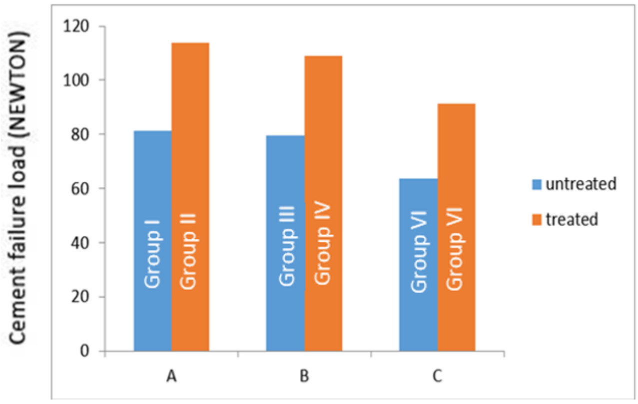
Source of variation	df	sum of squares	mean sum of squares	F-value	p-value
Cement	2	2816	1408.3	13.44	8.90e-05
Residuals	27	2829	104.8		

Table 8. Results of one way analysis of variance among cement A, B and C when used with sandblasted groups (Group II, Group IV and Group VI).

	B	C
A	0.5395	0.0001
B		0.0018

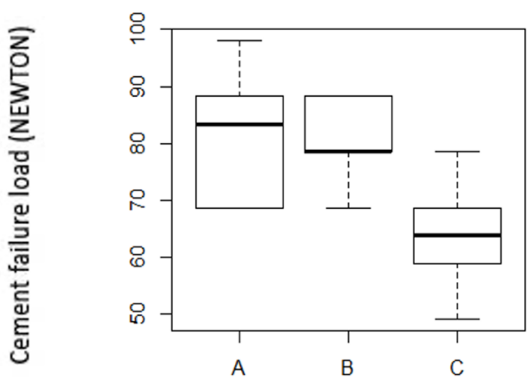
Table 9. Results of Tukey's post hoc test between cement A - cement B, cement A - cement C, and cement B - cement C when used with sandblasted groups.

where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.



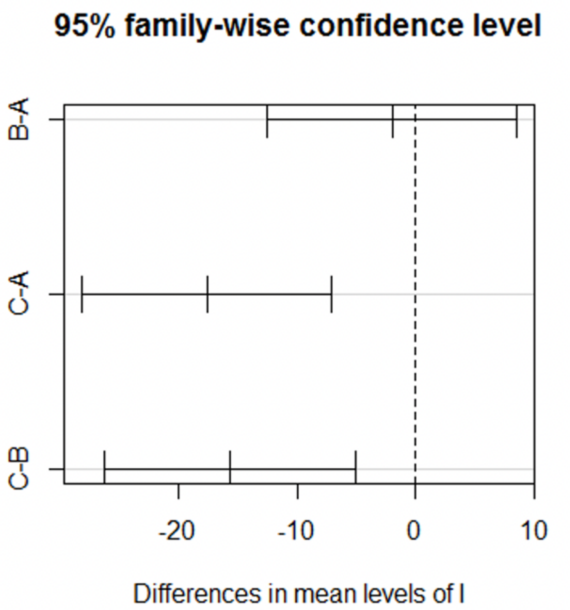
Graph 1. Mean cement failure load of three non-eugenol temporary cements between non sandblasted and sandblasted groups.

where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.

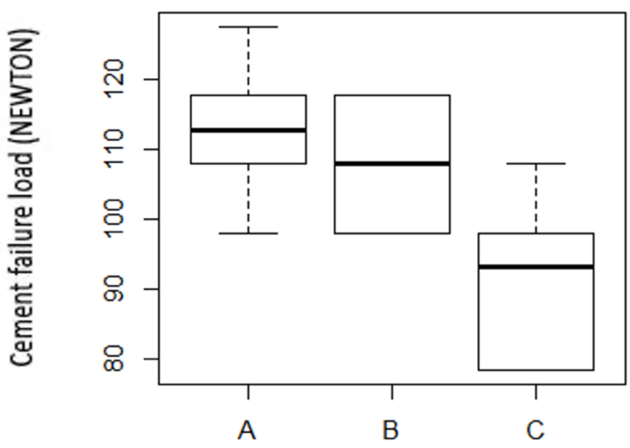


Graph 2. Box plot comparing cement failure loads among three non eugenol temporary cements in non sandblasted groups.

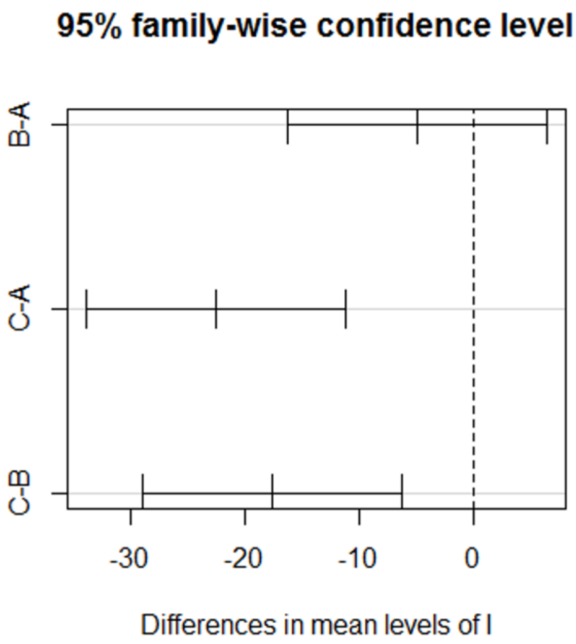
where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.



Graph 3. Mean cement failure load comparison between two luting cements in non sandblasted groups by Tukey's post hoc test.
where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.



Graph 4. Box plot comparing cement failure loads among three non eugenol temporary cements in sandblasted groups.
where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.



Graph 5. Mean cement failure load comparison between two luting cements in sandblasted groups by Tukey's post hoc test.
where, cement A is RelyX™ Temp NE.
cement B is OraTemp NE.
cement C is FREEGENOL TEMPORARY PACK.

CEMENT FAILURE LOAD

The cement failure loads of test specimens were determined by tensile pullout forces using universal testing machine. All the copings cemented with different luting cements separated from the Titanium abutment.

The values obtained for the cement failure loads of cemented copings are displayed in Table - 1. The data comprises the maximum loads at failure expressed in Newton (N). Higher mean cement failure load was recorded in Group II followed by Group IV. The next highest mean cement failure load was recorded in Group VI followed by Group I which was higher than Group III. Group V recorded the lowest mean cement failure load (TABLE - 2) and graphically represented (GRAPH - 1). The difference in mean cement failure loads before and after sandblasting recorded in the different groups of cements were found to be statistically significant ($P<0.05$).

In order to find out among which pair of groups there exist a significant difference, multiple comparisons using Paired t-test were carried out. The difference in mean cement failure load due to sandblasting between Group I and Group II was found to be statistically significant (P<0.05) (TABLE - 3). Also, statistically significant difference was found between Group III & Group IV (P<0.05) (TABLE - 4) and Group V & Group VI (P<0.05) (TABLE - 5)

The difference in mean cement failure load among non-sandblasted groups (Group I, Group III and Group V) were examined graphically (GRAPH - 2). Since there was significant difference (P<0.05) (TABLE - 6), Tukey's post hoc test was conducted to know which group showed significant difference. Results showed that, there was no significant difference between group I - group III. Values from group V - group III and group V - group I showed a significant difference (GRAPH - 3 and TABLE - 7).

Similarly, the difference in mean cement failure load among sandblasted groups (Group II, Group IV and Group VI) were examined graphically (GRAPH - 4). Since there was significant difference (p<0.05) (TABLE - 8), Tukey's post hoc test was conducted to know which group showed significant difference. Results showed that, there was no significant difference between group II - group IV. Values from group VI - group IV and group VI - group II showed a significant difference. (GRAPH - 5 and TABLE - 9).

Discussion

Cemented crowns have many advantages over screwed crowns, except for it's non retrievability. Retrievability may be thought of as representing a safety valve against problems such as fracture of the prosthesis, loosening or fracture of the abutment screw, and the need to modify the prosthesis.[15]

The type of cement is the deciding factor for retention if retrievability of the prostheses is the issue.[16] There are two main types of cements available for use in restorative dentistry, provisional and definitive cements. Provisional cements e.g. zinc oxide eugenol cement were developed for short term use and have low tensile strength. Definitive cements were developed to provide strong and lasting cementation for prostheses. Definitive cements are not recommended for implant retention because they make retrievability difficult. Also, with an implant-supported fixed prosthesis, the effect of lateral forces during removal of a cemented superstructure should be considered, as these forces may be more harmful to the implant/tissue interface than vertical forces.[17]

To overcome this problem, some clinicians recommend the use of temporary cements for definitive cementation of implant-retained prostheses. These kinds of prosthesis are associated with the advantages of esthetics and passive fit with the reversibility of cementation. Ideal taper and longer walls of the implant abutment allow for the use of provisional cement for long-term retention. This allows the operator to control the overall retention of prostheses by using a weaker cement to offset the superior retentive features of the implant abutment. As a result, practitioners who desire retrievability have gravitated towards using cements with sub-maximal retentive properties.[18]

Commonly used provisional cements are zinc-oxide eugenol and zinc-oxide noneugenol based. Zinc-oxide eugenol cements possess good sealing capability and antibacterial action. Eugenol, however, is a potential allergen. Discoloration of acrylic resin has been observed after 3 days of exposure to eugenol vapor. Eugenol-containing provisional cements later interferes with the bond between resin cement and prepared tooth for definitive cementations. Zinc-oxide non-eugenol cements replace eugenol with various types of carboxylic acids and do not interfere with definitive cementation.[19]

Aim of the study was to evaluate and compare the retentiveness of an implant supported restoration when used on abutments of varying texture with various provisional cements.

In the present study, cement failure load of metal copings luted to titanium abutments were determined to test the null hypothesis that cement failure load are similar regardless of the luting agent employed. The group of cements tested in this study were common dental provisional cements generally designated for temporary cementation.

According to Kaufman several factors influence the retention form of conventional cement-retained prostheses. These factors include the abutment, the casting, and the luting agent.[20]

All these factors excluding the type of cement and surface roughness of abutments were standardized for all specimens during the investigation.

In the present study prefabricated plastic copings were used in order to attain uniform built-in cement space of from 5 µm to 10 µm. The plastic burn-out coping system offers easy and predictable procedures to laboratory technicians. A space between the abutment and the plastic cap is premanufactured, which eliminates the need for a die spacer. The presence of this uniform cement space also decreases the need for casting adjustments.[21]

The cementation protocol which was used in this study were comparable with Ishikiriama et al and Akashi et al. A thin layer of fresh cement was spread into the metal coping's intaglio surface with a camel brush. They concluded that the marginal discrepancy was higher when the inner part of the crown is completely filled with fresh cement than when the cement is painted inside it with a camel brush.[22,23]

Koka et al suggested that filling the access opening is more important in terms of retention than the choice of definitive or provisional cement. Filling the abutment screw access channel may prevent cement escape into the internal abutment cavity, thus creating a greater internal cement pressure between the coping intaglio surface and the abutment, forcing cement into the micromechanical irregularities of the crown coping intaglio surface under pressure.[20] So, modelling wax was used to fill the access screw openings before the cementation procedures were carried out in this study. [24]

Provisional cement was used to completely cover all the internal walls of the castings, which were then seated onto the abutments by firm finger pressure for 10 seconds, followed by a 5 kg axial compressive load in a customized jig for 10 minutes which was comparable with the study done by Kuem et al and Akashi et al. Excess cement was removed using a plastic curette.[25,23]

Among various surface treatment methods, sandblasting influenced the crown retention regardless of the cement used. Sandblasted specimens luted with different cements showed the highest tensile bond strength compared to other surface conditioning methods.[26] Surface modifications of abutments by sandblasting, increased the retentive strength of cemented castings as a result of production of micro- and macro irregularities on the abutment surface which aids in improved retention.[27]

Surface roughness enhanced the micromechanical interlocking of luting agents to abutment surfaces, which explained the obtained result.[26]

The observation by Maeyama et al concluded that cement failure always occurred at the cement abutment interface. Surface treatment of the intaglio surface of metal copings did not provide any improvement in retentive potential. Thus, the surface treatment was carried out only on the abutments.[28]

Based on the statistical analysis of the results, the null hypothesis was rejected. The results obtained in the study indicated that metal copings cemented on titanium abutments with provisional cements, subjected to sandblastng were much more retentive than the other group which were not subjected to sandblasting. The amount of mean cement failure load of metal copings luted to titanium abutments showed 81.42 N for group I (non sandblasted abutments with RelyX™ Temp NE cement), 113.79 N for group II (sandblasted abutments with RelyX™ Temp NE cement), 79.46 N for group III (non sandblasted abutments with OraTemp NE cement), 108.89 N for group IV (sandblasted abutments with OraTemp NE cement), 63.76 for group V (non sandblasted abutments with FREEGENOL TEMPORARY PACK cement) and 91.23 for group VI (sandblasted abutments with FREEGENOL TEMPORARY PACK cement). Statistical analysis using ANOVA test showed significant difference ($P<0.05$) between the groups with respect to the mean tensile strength between treated and untreated groups of each cements. Multiple comparisons were made using Paired t-test. Test results revealed that there was a significant difference in tensile strength ($p<0.05$) between all cements of untreated as well as treated category.

However, the FREEGENOL TEMPORARY PACK cement showed least retentive values, which were comparable with results obtained in the study by Rego et al.[29] Nevertheless, weakness of the retentive strength could serve other purposes. For example, the lower strength of the provisional cements would facilitate easy retrieval of the prosthesis whenever needed, along with cleaning of the extra cement adhering to it, without damaging the abutment surface.

Conclusions

In this study, the retentive nature of common provisional dental cements used with implant systems were determined. Mixing speed, number of mixing strokes per unit time, mixing temperature and humidity of mixing atmosphere were not considered. However, the same operator in similar conditions manipulated all the cements. Careful consideration of the choice of cement should include reference to the abutment and crown specifications, opposing surface characteristics, desired retention and individual properties of the preferred cement. No single retrievable cement can suffice for all clinical situations.

In the present study, a direct tensile force was applied along the long axis of the cemented copings. However, the crowns in-vivo are rarely subjected to this force except when masticating high viscosity foods that adhere to the occlusal surfaces.[30] The complex forces, which are applied to the crown's interfaces, may be resolved to tensile, shear and compressive forces depending on the surfaces of the tooth under investigation. Findings from several in-vitro studies have indicated that direct tensile loading can be considered to relate to the clinical situation when standardized methods during the specimen fabrication are followed.[31]

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Declaration of Interest

The authors report no conflict of interest.

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