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Influence of Resin Cements on Fracture Resistance of Lithium Disilicatemonolithic Ceramic Restorations

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Abstract
Objective: *The purpose of this study was to evaluate the effect of adhesive and self-adhesive resin cements on fracture resistance of lithium disilicate restorations.*
Materials and methods: *Eighty intact human maxillary premolars were prepared and divided into four groups (n=200) according to type of restoration and type of resin cement; adhesive and self adhesive resin cements. The restorations were subjected to thermocycling (10000 cycle between 5 °Cand 55 °C). Fracture load (N) was applied to all specimens under static compressive load. The results were tabulated and statistical analysis was done with t student test, one way ANOVAmethod.(P = .05).*
Results: *t student test showed there was no statistical significant difference between means fracture resistance of test groups with different resin cements (P=.978).*
Conclusions: *Type of cement did not affect the fracture resistance of ceramic restoration used.*
Key Words: *Resin cement, CAD/CAM, Fracture resistance, lithium disilicate.*

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I. Introduction

The primary function of dental cement is to fill the space between restoration and tooth preparation, as well as to enhance the resistance against dislodgement during function.[1,2] Of utmost importance, the long-term success of a restoration is heavily dependent on the proper selection and manipulation of dental cements.[2]Resin cements have the ability to bond the tooth structure and the internal surface of the restoration.[3] Resin cements have the advantages of high compressive/bonding strength, low solubility, and esthetics[4]. These properties allow them to be employed in cases where there are concerns about retention or with weak and esthetic restorations such as restorations made from glass-ceramic and composite resin.[4] Resin cements play an important role by resin infiltration that sealed microcracks at the material surface, reduced the flaws and increasing the energy required for crown catastrophic fracture during loading.[5] Polymerization of dual cure resin cement influenced by type and thickness of the overlaying ceramic.[6]Self-adhesive resin cements are cements based on filled polymers designed to adhere to tooth structure without the necessity of separate etching, drying and priming.[7] Self-adhesive resin cements were developed to provide dental cement with a simple application procedure.[7] Nano-indentation testing on different self- etch adhesive system suggested that when properly handled, two-step self-etch adhesive may perform better than one-step self-etch adhesive.[8]

Metal-free restorations became more important in dentistry due to increased esthetic requirements.[9] Nowadays, more patients want to avoid placement of a metallic restoration intraoral, and clinicians also want to follow this trend for a better esthetic outcome.[10] The qualitative improvements provided ceramic materials with many advantages over the porcelain-fused-to-metal system such as excellent esthetics due to favourable optical properties, natural tooth color and chromatic stability, biocompatibility, chemical inertness and low thermal conductivity, good mechanical properties such as high flexural strength and fracture toughness, as well as wear resistance and low abrasive properties.[11,12,13]

Lithium disilicate ceramic is comprised of approximately 70 vol% of crystalline phase incorporated in the glassy matrix.[14] In the process of production, ceramic is cast in transparent glass ingots that contain lithium orthosilicate.[15] The process of partial crystallization that follows leads to the formation of 40% platelet-shaped lithium metasilicate crystals (with the average size of 0.2-1.0 µ), embedded in a glassy phase.[14] It is a so-called intermediate crystalline phase, with 130 MPa flexural strength, in which the blocks can easily be milled in CAM unit.[16] Milled restorations impart the milled restorations with the final shade and flexural strength of 360 MPa.[14]IPS e.max Press (IvoclarVivadent) has high strength and pleasing esthetic properties sufficient to allow its use for veneers, single crowns and copings.[17]

Fracture resistance is defined as, the ultimate stress necessary to cause fracture or plastic deformation and is strongly affected by the size of flaws and defects present on the surface of the tested materials. Strength is an important mechanical property that determines the performance of brittle materials.[18]The null hypothesis of current study was that adhesive and self-adhesive resin cement may affect fracture resistance oflithium disilicate monolithic ceramic restoration.

II. Materials And Methods

Extracted human maxillary first premolar teeth free of caries or fractures were selected with similar buccolingual, mesiodistal and occlusocervical dimensions, as determined. The teeth were disinfected by immersion in 5% sodium hypochlorite for 20 minutes at room temperature then thoroughly washed with water and stored in 0.09% standardized saline solution at room temperature until use.

Eighty teeth were prepared to receive lithium disilicate monolithic ceramic restorationdivided into two main groups according to type of resin cement: LDs with self-adhesive resin cement and LDs with adhesive resin cement.CAD/CAM system used for standardization the preparation of the tooth.[19] Standardization starts with 2 teeth were prepared by operator used hand piece attached to dental surveyor. Ceramic restorations were constructed by lithium disilicate. The margins thickness was 1 mm.

Intaglio surface of lithium disilicate restorations were treated with 9% hydrofluoric acid for 20 seconds, rinsed and dried according to instructions of manufacture. The light curing bonding agent was worked into the tooth substance for 20 seconds. The material was withdrawn and applied directly by a brush. The bonded tooth surface were gently oil-free air blowed for 5 seconds to achieve a uniform even surface, then light cured for 20 seconds according to the instructions of manufacture. An appropriate amount of the cement was dispensed and distributed equally on the fitting surface of ceramic restorations. Then, each restoration was gently seated on its corresponding prepared tooth surface with slight finger pressure for proper seating. The samples were inserted into a specially designed loading device under constant pressure of 10 N to standardize the load applied during cementation procedure then light cured for 20 seconds for each surface according to manufacture instructions. The specimens were mounted in the center of the PVC pipe with self-curing resin.

Specimens were subjected to 10000 cycles of thermal cycle using (Thermo-cycler SD Mechatronic, Germany) at temperature between 5 ℃ and 55 ℃ for 20 seconds at 10 seconds dwell time.[20] All specimens were subjected to static compressive axial load using instron universal testing machine (Model 3345, Instron, Canton, MA, USA) at a crosshead speed 0.5 mm/min.

III. Results

According to resin cement type, t student test showed no significant difference as ($t= 0.028$, $P=.978$) as listed in **Table 1.**

Table 1. Comparison of fracture resistance (N) between G-CemLinkForce and Panavia SA.

Adhesive resin cement n=40 Mean±SD	Self-adhesive resin cement n=40 Mean±SD	Test of significance
1091.1±417.08	1093.9±479.44	t=0.028 *P*=0.978

IV. Discussion

The null hypothesis was partially accepted. Esthetic material was used in this study for fabrication of restorations. IPS e.max Press was used for its unique combination of strength and esthetic properties as natural tooth color, excellent translucency and brightness.[9]

Natural freshly extracted teeth were chosen in this study to be prepared to receive the tested restorations instead of stainless, epoxy resin and composite resin dies which do not reproduce the real force distribution as that occurring on crowns cemented to human teeth.[21] On the other hand, dentin exhibits a lower modulus of elasticity than stainless steel and as a consequence, the inner crown surface shows a greater shear stress every time the tooth is subjected to deformation.[22]Acrylic resin was chosen for mounting the teeth with addition silicon light body that simulate periodontal ligament. The periodontal ligament is an important structure for the stress distribution generated by load application over teeth.[23]

Adhesive and self-adhesive resin cements were used in this study as they had simple and non-sensitive technique, eliminating the need for separate etching.[8]This saved time and greatly reduced potential for patient sensitivity. Generally, resin cements play an important role by resin infiltration that sealed micro cracks at the material surface, reduced the flaws and increasing the energy required for crown catastrophic fracture during loading.[5]

In this study, means fracture resistance values had non-significant difference between self adhesive and adhesive group. These results were in agreement with study reported that no significant differences were noticed among the fracture resistance of Panavia F and RelyX Unicem.[24] Also, another studyreported that no significant differences were noticed among the fracture resistance of Panavia F 2.0 and RelyX Unicem.[25] That may related to both Panavia F and RelyXUnicem consist of multifunctional phosphoric acid dimethacrylate modified monomers, such as Bis-GMA, and inorganic fillers of fine glass and silica.

Increase fracture resistance in lithium disilicate cemented by adhesive resin cement group may related to that polymerization of dual cure resin cement influenced by type and thickness of the overlaying ceramic[6] and since lithium disilicatehas higher translucency and light transmission so allow for more polymerization. Also, mechanical properties such as hardness and young's modulus of resin-dentin bonding can be measured by nano-indentation testing. Nano-indentation testing on different self- etch adhesive system suggested that when properly handled, two-step self-etch adhesive may perform better than one-step self-etch adhesive.[8]

V. Conclusions

- Type of cement did not affect fracture resistance of lithium disilicate restorations.

VI. Recommendations

Further in-vitro studies recommended for comparing results of research, in-vivo studies recommended for investing fracture resistance using different ceramic restoration materials and different cements, and recommendations of long-term study.

References

[1]. **Hill EE.** Dental cements for definitive luting: A review and practical clinical considerations. *Dent Clin North Am*. 2007;51:643-658.
[2]. **Hill EE, Lott J.** A clinically focused discussion of luting materials. *Aust Den J*. 2011;56:67-76.
[3]. **Grzegorz S, Agata S, Kinga B.** Dental resin cements-The influence of water sorption on contraction stress changes and hydroscopic expansion. Materials (Basel). 2018;11:973.
[4]. **Christensen GJ.** Why use resin cements? *J Am Dent Assoc*. 2010;141:204-206.
[5]. **Johansson C, Kmet G, Rivera J, et al.** Fracture strength of monolithic all-ceramic crowns made of high translucent yttrium oxide-stabilized zirconium dioxide compared to porcelain-veneered crowns and lithium disilicate crowns. Acta Odontologica Scandinavica. 2014;72:145-153.
[6]. **Turp V, Turkoglu P, Sen D.** Influence of monolithic lithium disilicate and zirconia thickness on polymerization efficiency of dual cure resin cements. *J EshetRestor Dent*.2018;30:360-368.
[7]. **Makkar S, Malhotra N.** Self-adhesive resin cements: a new perspective in luting technology. Dental update. 2013;40:758-768.
[8]. **Giannini M, MakishiP, Ayres A, et al.** Self-etch adhesive systems: a literature review. *Brazil Dent J.* 2015;16:3-10.
[9]. **Raptis N, Michalakis K, Hirayama H.** Optical behavior ofcurrent ceramic systems. *Int J PeriodontRestor Dent.* 2006; 26:31–41.
[10]. **Preis V, Hahnel S, Behr M, et al.** In-vitro fatigue and fracture testing of CAD/CAM-materials in implant-supported molar crowns . *Dent Mater.* 2017; 33:427–33.
[11]. **Zarone F, Russo S, Sorrentino R.** From porcelain-fused-to-metal to zirconia: Clinical and experimental considerations. *Dent Mater.* 2011;27:83-96.
[12]. **Bajraktarova E, Korunoska V, Kapuseveska B, et al.** Contemporary dental ceramic materials, a review: Chemical composition, physical and mechanical properties, indications for use. *Open Acess Maced J Med Sci.* 2018;6:1742-1755.
[13]. **Naji G, Omar R, Yahya R.** An overview of the development and strengthening of all-ceramic dental materials. *Biomed Pharmacol J.* 2018:11.
[14]. **Li R, Chow T, Matinlinna J.** Ceramic dental biomaterials and CAD/CAM technology: State of the art. *J Prosthet Dent*. 2014;58:208-216.
[15]. **Le FU, Engqvist H, Xia W.** Glass-ceramics in dentistry: Av review. Materials (Basel). 2020;13:1049.
[16]. **Montazerian M, Zanotto E.** Bioactive and inert dental glass-ceramics. *J Biomed Mater Res.* 2017;105:619-639.
[17]. **Wolfart S, Eschbach S, Scherer S, et al.** Clinical outcom of three-unite lithium di-silicate glass-ceramic fixed dental prostheses: up to 8 years results. *Dent Mater.* 2009;25:63-71.
[18]. **Daronch M, Rueggeberg FA, Goes MF.** Monomer conversion of Pre-heated composite. *J Dent Res.* 2005; 84:663-667.
[19]. **Danzer R, Lube T, Supanic P, et al.** Fracture of ceramics. Advanced engneering materials. 2008;10:275-298.
[20]. **Kasim A, Sakrana A, Ellayh M, et al.** Evaluation of zirconia and zirconia reinforced glass ceramic systems fabrication for minimal invasive preparation using a novel standardization method. *J EsthetRestor Dent.* 2020;32;1-9.
[21]. **Gale M, Darvel B.** Thermal cycling procedure for laboratory testing of dental restorations. *J Dent.*1999;27:89-99.
[22]. **Jalalian E, Aletaha N.** The effect of two marginal designs (chamfer and shoulder) on the fracture resistance of all ceramic restorations, Inceram: an in vitro study. *J Prosthodont Res.* 2011; 55:121–5.
[23]. **Potiket N, Chiche G, Finger I.** In vitro fracture strength of teeth restored with different all-ceramic crown systems. *J Prosthet Dent.* 2004; 92:491–5.
[24]. **Soares C, Pizi E, Fonseca R, et al.** Influence of root embedment material and periodontal ligament simulation on fracture resistance tests. *Braz Oral Res.* 2005; 19:11-6.
[25]. **Nakamura K, Mouhat M, Nergård JM, et al.** Effect of cements on fracture resistance of monolithic zirconia crowns. Acta Biomater Odontol Scand. 2016;2:12-19.