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I. INTRODUCTION

In clinical dentistry, the use of all-ceramic restorations has increased in an early basis since they provide excellent esthetic and high mechanical performance. Moreover, the introduction of CAD-CAM technologies has contributed to simplifying the manufacturing of dental prosthesis, further contributing to the use of ceramic restorative materials. (1)

Investigators and manufacturers have made admirable efforts to produce dental ceramics replicating both esthetic and mechanical properties of natural teeth.(2)

The most recent introduction to the dental ceramic's family is zirconia, which in its pure form is a polymorphic material that occurs in three temperature-dependent forms that are: monoclinic (room temperature to 1170 °C), tetragonal (1170 °C–2370 °C) and cubic (2370 °C – up to melting point).(3)

The significant clinical acceptance of zirconia for use in indirect dental prostheses has led to numerous dental material companies selling zirconia because of the simplicity of its fabrication, white color, and improved mechanical properties. Zirconia has been increasingly used for multiple dental applications, such as the fabrication of all-ceramic copings, fixed partial prostheses,(4,5) and full-arch dental prostheses,as well as implant abutments and implants.(6)

Clinical success of all-ceramic restorations is widely dependent on establishing a strong and stable bond between these materials and dental hard tissues. All-ceramic restorations can be luted either by conventional or resin-based adhesive protocols, but the adhesive cementation is desired to achieve a strong and stable interface between ceramic restorations and tooth structure.(7)

Although superior in terms of mechanicalperformance (strength, toughness, fatigue resistance)when compared to alternative materials, a consistentproblemassociated with zirconia is poor adhesion to the varietyof substrates (synthetic or tissues) that can be encountered indental or other biomedical applications.(8,9)

Conventional cementationattachment techniques used with zirconia componentsdo not provide sufficient bond strength for many of these clinicalapplications due to the inert nature of zirconia.(9)

Some clinical studies have reported the loss of retention of zirconia crowns due to the difficulty to establish a reliable bonding between zirconia substrate and resin cement, showing the need for the establishment of a protocol that will result in a more predictable bonding between zirconia-based restorations and tooth substrate.(10,11)

The combination of grit blasting and chemical pre-treatments increased the bond strength between zirconia and resin-based cements.(12)

Air abrasion with aluminum oxide particles aims to roughen the internal surface of the ceramic restorations to optimize the adhesion area and promote better mechanical interlocking with the resin cement.(13,14)

In terms of chemical bonding the application of 10-methacryloyloxydecyl dihydrogenphosphate (MDP)-containing bonding agentscan increase bond strength to zirconiabecause of aninteraction between the hydroxyl groups of MDP and thecationic surface of zirconia.(15)

A simplified zirconia bonding concept (the APC zirconia bonding concept) summarizes the 3 critical procedural steps: (16)

- **APC – Step A**: Air-particle zirconia abrasion with aluminum oxide.
- **APC – Step P**: Priming of abraded zirconia with 10-MDP.
- **APC – Step C**: Cementation with a dual-polymerizing or self-polymerizing composite-resin luting agent. (16)

Dental cements are designed to retain restorations, appliances, and posts and cores in a stable and, presumably, long-lasting position in the oral environment. Retention mechanisms for restorations secured by cements are reported to be chemical, mechanical (friction), and micromechanical (hybridized tissue). Retention of the restoration is usually achieved by a combination of two or three mechanisms depending on the nature of the cement and the substrate.(17)

Many dental cements are commercially available, including resin-based and non–resin-based cements.(18)

Resin-based cements are generally used for esthetic restorations (ceramic or resin based) and have become popular because they have addressed the disadvantages of solubility and lack of adhesion noted in previousmaterials. (19)

The adhesive luting technique can be classified according to the adhesive system utilized:(20)

a) **etch-and-rinse**; **a multistep** adhesive with one or two bottles.

b) **Self-etch** primer or adhesive, containing acidic monomers that demineralize enamel/dentin without rinsing.

c) A **self-adhesive** resin cement that does not use a separate adhesive system.

In vitro studies have shown promising results in terms of the bond self-adhesive resin cements to dentin and to restorative materials such as composite resin and ceramic.(21)

Aim of study

The aim of this in-vitro study is to:

Evaluate bonding durability of monolithic zirconia with different core materials using two resin cements.

II. MATERIALS AND METHODS

Materials:

Materials will used in this study will be:

1. Zirconia ceramics.
2. Luting cement (Self-adhesive resin cement, Multistep resin cement)
3. Different core materials:

A. Dentin
B. Enamel
C. Glass ionomer core
D. Composite resin core

Methods:

A total of 64 zirconia ceramic discs will be laboratory fabricated and sandblasted with 50-µm aluminum oxide ($Al_2 O_3$) particles, ultrasonically cleaned for 5 minutes in 95% alcohol and air dried.

Teeth Disinfection and Storage:

Sound bovine teeth caries and cracks free, recently extracted will be collected according to the approved protocol of the ethical committee of faculty of dentistry.

Then selected teeth were cleaned ultrasonically from calculus or any debris and disinfected in 1:10 diluted 5.25% sodium hypochlorite household bleach for one week, based on recommendation of the Centers for Disease Control and Prevention (CDC). Then the teeth were stored in distilled water at room temperature during the study period to avoid dehydration with taking in consideration changing the water weekly to avoid bacterial formation.

Zirconia discs will be divided into 4 test groups (n=16) according to core material:

Group (1): will be bonded with dentin.

Group (2): will be bonded with enamel.

Group (3): will be bonded with glass ionomer core.

Group (4): will be bonded with composite resin core.

Each main group will be subdivided into 2 subgroups (n=8) according to luting cement:

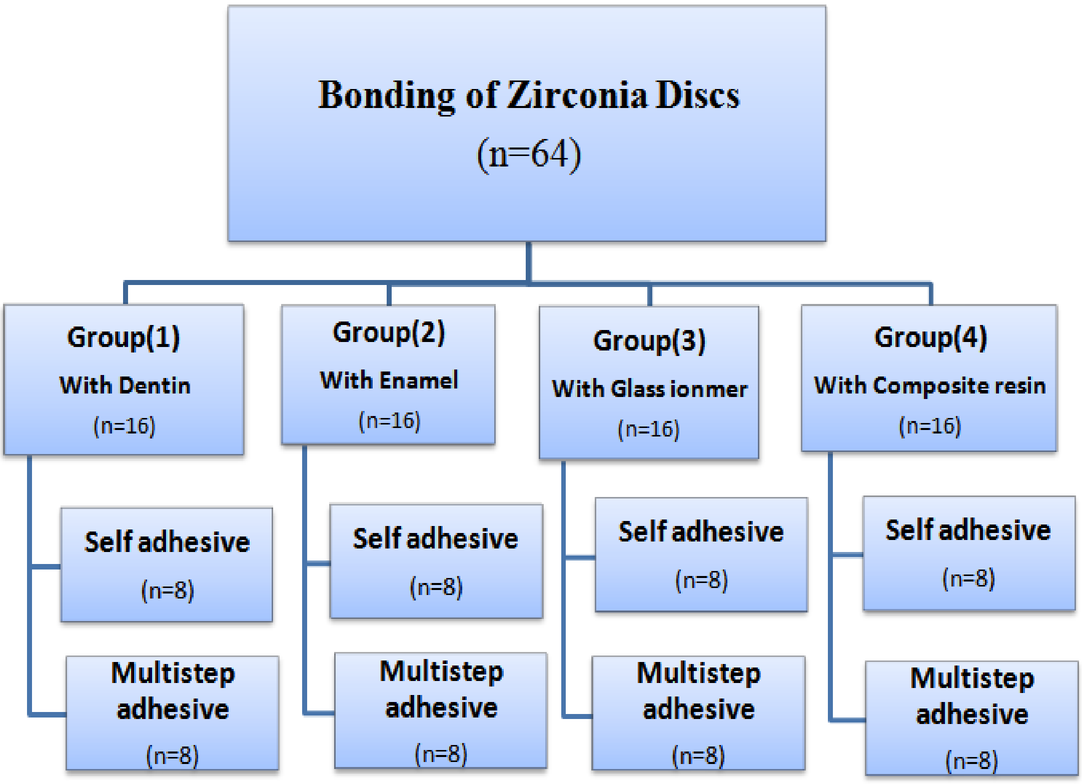
Subgroup (A): Self-adhesive resin cement.

Subgroup (B): Multistep adhesive resin cement

Zirconia discs will be bonded to different core materials according to manufacturer instruction of each luting cement.

One hour after cementation bonded specimens will be stored in water bath at 37°C for 2 months followed by thermal cycling for 2000 thermal cycles. A universal testing machine will be used for recording bond strength of each bonded specimen. Data will be collected and tabulated for statistical analysis.

Diagram showing study design



REFERENCES

[1]. Raigrodski AJ, Hillstead MB, Meng GK, Chung KH. Survival and complications of zirconia-based fixed dental prostheses: a systematic review. J Prosthet Dent 2012; 107:170–7, http://dx.doi.org/10.1016/S0022-3913(12)60051-1.

[2]. Li RW, Chow TW, Matinlinna JP: Ceramic dental biomaterials and CAD/CAM technology: state of the art. J Prosthodont Res 2014;58:208-216

[3]. Denry I, Kelly J. State of the art zirconia for dental applications.

[4]. Dent Mater. 2008;24:299–307.

[5]. Denry I, Kelly JR. State of the art of zirconia for dental applications.Dent Mater. 2008; 24:299-307.

[6]. Miyazaki T, Nakamura T, Matsumura H, Ban S, Kobayashi T. Currentstatus of zirconia restoration.J Prosthodont Res. 2013;57:236-261.

[7]. Abdulmajeed AA, Lim KG, Narhi TO, Cooper LF. Complete-archimplant-supported monolithic zirconia fixed dental prostheses: a sys-tematic review.J Prosthet Dent. 2016; 115:672-677.e1.

[8]. Ernst CP, Cohnen U, Stender E, Willershausen B. In vitroretentive strength of zirconium oxide ceramic crowns usingdifferent luting agents. J Prosthet Dent 2005; 93:5518, http://dx.doi.org/10.1016/j.prosdent.2005.04.011.

[9]. Blatz MB, Sadan A, Kern M. Resin-ceramic bonding: a review of the literature. J Prosthet Dent 2003;89(2):268–74.

[10]. Blatz MB, Chiche G, Holst S, Sadan A. Influence of surface treatment and simulated aging on bond strengths of luting agents to zirconia. Quintessence Int 2007;38(9):745–53.

[11]. Morimoto S, Rebello de Sampaio FB, Braga MM, Sesma N,Özcan M. Survival rate of resin and ceramic inlays, onlays,and overlays: a systematic review and meta-analysis. J DentRes 2016; 95:985–94.

[12]. Thoma DS, Sailer I, Ioannidis A, Zwahlen M, Makarov N,Pjetursson BE. A systematic review of the survival and complication rates of resin-bonded fixed dental prosthesesafter a mean observation

period of at least 5 years. Clin OralImplants Res 2017; 28:1421–32.

[13]. Inokoshi M, De Munck J, Minakuchi S, Van Meerbeek B.Meta-analysis of bonding effectiveness to zirconia ceramics Dent Res 2014;93(4):329–34,http://dx.doi.org/10.1177/00220345145 24228.

[14]. Qeblawi DM, Mun˜ oz CA, Brewer JD, & Monaco EA Jr (2010) The effect of zirconia surface treatment on flexural strength and shear bond strength to a resin cement Journal of Prosthetic Dentistry 103(4) 210-220.

[15]. Mattiello RDL, Coelho TMK, Insaurralde E, Coelho AAK, Terra GP, Kasuya AVB, Favara˜o IN, Gonc¸alves LS, & Fonseca RB (2013) A review of surface treatment methods to improve the adhesive cementation of zirconia-based ceramics International Scholary Research Notices Biomaterials Article ID 185376, 10 pp.

[16]. Ozcan M, Nijhuis H, Valandro LF. Effect of various surface conditioning methods on the adhesion of dual-cure resin cement with MDP functional monomer to zirconia after thermal aging. Dent Mater J 2008;27:99-104.

[17]. Blatz MB, Alvarez M, Sawyer K, et al: How to bond zirconia: the APC concept. Compend Contin Educ Dent 2016;37:611-617

[18]. Meyer JM, Cattani-Lorente MA, Dupuis V. Compomers: between glass-ionomer cements and composites. Biomaterials 1998;19:529–39.

[19]. O'Brien WJ. Dental materials and their selection. 3rd edition. Chicago: Quintessence; 2002.

[20]. Meyer JM, Cattani-Lorente MA, Dupuis V. Compomers: between glass-ionomer cements and composites. Biomaterials 1998;19:529–39.

[21]. Radovic I, Monticelli F, Goracci C, Vulicevic ZR, Ferrari M. Self-adhesive resin cements: A literature Review. J Adhes Dent 2008; 10:251-258.

[22]. Frankenberger R, Lohbauer U, Schaible RB, Nikolaenko SA, Naumann M. Luting of ceramin inlay in vitro: Marginal quality of self-etch and etch-and -rinse adhesive versus self-etch cements. Dent Mater 2008;24:185-191.