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Influence of Surface Conditioning of Different Core Materials on Bonding to Glass Ceramic

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I. INTRODUCTION

All-ceramic restorations have become increasingly popular in recent years, mainly due to improved adhesion technology and esthetic appearance. Silica based ceramics are routinely luted adhesively to provide strength for the ceramic restoration and to ensure a secure attachment to (dental hard tissues).[1]

Lithium disilicate glass ceramics are a new generation of ceramics that provide high fracture strength and bending resistance, when compared with feldspar ceramics. The presence of lithium disilicate crystals improves the overall characters of the final ceramic restoration. These features enable the fabrication of onlays, inlays, laminate veneers, crowns and three-unit fixed dental prosthesis bridges extending to the first molar.[2]

In contrast, high-strength ceramic materials （e.g., zirconia-based ceramics）offer the possibility to be luted either conventionally or adhesively [3]. Conventionally luted restorations require adherence to a well-defined preparation, whereas strict preparation guidelines do not exist for adhesively luted silica based ceramic inlays and onlays- apart from the guarantee of a sufficient thickness of the ceramic. [3,4]

Conditioning dental ceramics using hydrofluoric acid and silane provides increased chemical bonding by assisting contact with the ceramic due to the presence of bi-functional molecules.[5.6]

As zirconia is considered as an acid-resistance ceramic, other methods to produce micromechanical retention have been used, including airborne particle abrasion (APA) systems, often called sandblasting with alumina or silica-modified alumina particles, glass beads, abrasion with diamond rotary instrument, laser abrasion, acid etching, or a combination of these techniques. Several studies reported that airborne particle abrasion methods using alumina particles or silica-modified alumina particles (silica coating) produced greater surface roughness (Ra) values and that silica coated surfaces showed a significant increase (76%) in the concentration of silicon, which should enhance bonding to resin via silane coupling agents.[7.8.9]

Surface treatments of ceramics are a fundamental necessity for bonding and influence the appearanceof the restoration and even microbial retention [10,11].

A variety of techniques have been proposed to improve the bond strength of ceramic to composite resins. These surface treatment methods range from roughening the surface（air-borne particle abrasion）oretching（withhydrofluoric（HF）aci d）to silica coating. HF acid has been shown to be effective in roughening the composite surface so as to increase the bond strength of some resin composite materials.

In contrast, with some resin composites, treatment with HF did not bear out the intended effect of improved bond strength[12]. Alternatively, airborne particle abrasion with aluminum trioxide particles modified with silica- which has been introduced in the late 1980s has been proven to be effective for conditioning composite resins, high-strength ceramics, and metal surfaces[13].

The blasting pressure causes these silica-coated alumina particles to be embedded within the surface. Following the application of a silane coupling agent, the modified surface structure is thereby rendered more reactive with the resin, hence enabling chemical adhesion between both surfaces [14].

Numerous composite resin cements and adhesive systems are available for bonding silica-based ceramic restorations, and their performance has been investigated by several researchers [15].

The zirconia surface can be modifed with new conditioning materials for zirconia-ceramic bond improvements, increasing the surface area making it favorable for mechanical interlocking which are needed to reduce the failures of this type of restoration [16,17].

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Debonding of ceramic restorations is a technical complication reported in many studies [18,19] and might occur either between cement and tooth substance, between cement and ceramic or within the cement layer. Surface treatment of zirconia aims at increasing bond strength of resin cemented restorations. Still there is no consensus about the optimal treatment [20].

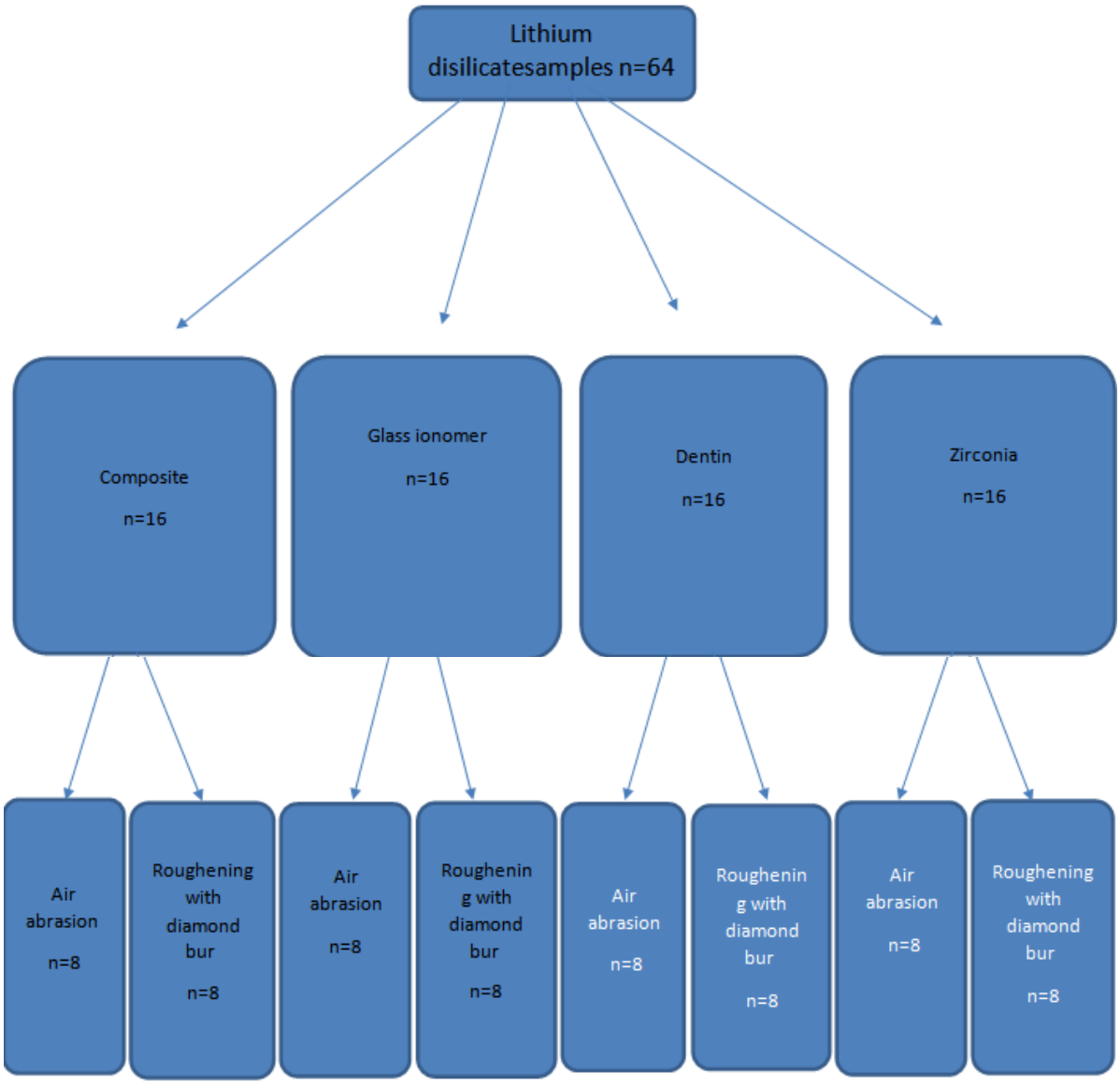
Concerning the role of composite resin cements in luting ceramic restorations to dental hard tissues, several studies have been undertaken to investigate the bonding effectiveness of composite resin cements. However, information is scarce concerning the bond strength between dental hard tissues as well as resin core materials and ceramics.

II. AIM OF THE STUDY

This in vitro study will evaluate:

Influence of surface treatment of different core materials on bonding to lithium disilicate glass ceramic.

Diagram showing the study design



The following materials will be used in this study:

1) Machinable ceramic (Lithium disilicate ceramic).
2) Composite
3) Dentin.
4) Glass ionomer.
5) Zirconia
6) Adhesive resin cement

Methods:

A total of 64 ceramic samples will be laboratory fabricated and divided into4 main groups (n=16) according to core material to be used**:**

Group 1 (n=16) composite
Group 2 (n=16) glass ionomer
Group 3 (n=16) dentin
Group 4 (n=16) zirconia

Each group will be subdivided into 2 subgroups (n=8) according to surface treatment of core material either micro air abrasion or roughening with diamond bur.

Group 1: Micro air abrasion (n=8)
Group 2: Roughening with diamond bur (n=8)

Intaglio surface of ceramic specimens will be etched with HF acid followed by silane application. Conditioned surface of core discs will be bonded to intaglio surface of ceramic specimens. One hour after cementation, bonded specimens will be stored in water bath at 37℃ for 5 months followed by thermal cycling for 3000 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.

REFERENCES

[1]. DiTolla MC: A new metal-free alternative for single- and multiunit restorations. Compend Contin Educ Dent 2002; 23(9 Suppl 1): 25- 33

[2]. Song XF, Ren HT, Yin L. Machinability of lithium disilicate glass ceramic in in vitro dental diamond bur adjusting process. J .MechBehav Biomed Mater. 2016;53:78-92

[3]. Ritter AV and Baratieri LN. Ceramic restorations for posterior teeth: Guidelines for the clinician. J Esthet Dent 1999; 11: 72-86.

[4]. McDonald A. Preparation guidelines for full and partial coverage ceramic restorations. Dent Update 2001; 28: 84-90.

[5]. Elbasty R, Taymour M. Assessment of resin -ceramic bond strength under various pH conditions for different ceramic materials subjected to two surface treatment protocols. Egypt Dent J. 2019;65(1):667-679.

[6]. Nogueira IDO, Gomes F, Magno B, Masterson D, PereiraT, Maia C. Does the application of an adhesive layer improve the bond strengthofetched and silanized glass ceramics to resin-based materials ? A systematic review and meta-analysis. J Prosthet Dent. 2020;123(2):204-214.

[7]. Khanlar LN, Takagaki T, Abdou A, Inokoshi M, Ikeda M, Takahashi A, Yoshihara K, Nagaoka N, Nikaido T, Blatz MB, Tagami J. Effect of AirParticle Abrasion Protocol and Primer on The Topography and Bond Strength of a High-Translucent Zirconia Ceramic. J Prosthodont. 2022 Mar; 31(3):228-.238

[8]. Della Bona, A.; Borba, M.; Benetti, P.; Pecho, O.E.; Alessandretti, R.; Mosele, J.C.; Mores, R.T. Adhesion to dental ceramics. Curr. Oral Health Rep. 2014;1:232–238.

[9]. Lung CY, Matinlinna JP. Aspects of silane coupling agents and surface conditioning in dentistry: an overview. Dent Mater. 2012 May;28(5):467-77

[10]. Poole, S.F.; Pitondo-Silva, A.; Oliveira-Silva, M.; Moris, I.C.M.; Gomes, E.A. Influence of different ceramic materials and surfacetreatments on the adhesion of Prevotella intermedia. J. Mech. Behav. Biomed. Mater. 2020, 111, 104010. [CrossRef] [PubMed]

[11]. Anunmana C, Wansom W. Bonding measurement— strength and fracture mechanics approaches. Dent Mater J. 2017;36(4):497–502

[12]. Özcan M, Alander P, Vallittu PK, Huysmans MC, Kalk W. Effect of three surface conditioning methods to improve bond strength of particulate filler resin composites. J Mat Sci Mater Med 2005; 16: 21-27.

[13]. Blixt M, Adamczak E, Linden LA, Oden A, Arvidson K. Bonding to densely sintered alumina surfaces: Effect of sandblasting and silica coating on shear bond strength of luting cements. Int J Prosthodont 2000; 13: 221-226.

[14]. Matinlinna JP, Lassila LV, Özcan M, Yli-Urpo A, Vallittu PK. An introduction to silanes and their clinical applications in dentistry. Int J Prosthodont 2004; 17: 155-164.

[15]. Kumbuloglu O, Lassila LV, User A, Toksavul S, Vallittu PK. Shear bond strength of composite resin cements to lithium disilicate ceramics. J Oral Rehabil 2005; 32: 128-133.
[16]. Kirmali O, Kustarci A, Kapdan A, Er K. Efcacy of surface roughness and bond strength of Y-TZP zirconia after various pretreatments. Photomed Laser Surg. 2015;33(1):15–211.
[17]. Yamamoto LT, Rodrigues VA, Dornelles LS, Bottino MA, Valandro LF, de Melo RM, et al. Low-fusing porcelain glaze application on 3Y-TZP surfaces can enhance zirconia-porcelain adhesion. Braz Dent J. 2016;27(5):543–7.
[18]. Quigley NP, Loo DSS, Choy C, et al. Clinical efficacy of methods for bonding to zirconia: a systematic review. J Prosthet Dent. 2021;125(2):231–240.
[19]. Gardell E, Larsson C, von Steyern PV. Translucent zirconium dioxide and lithium disilicate: a 3-year follow-up of a prospective, practice-based randomized controlled trial on posterior monolithic crowns. Int J Prosthodont. 2021;34(2):163–172
[20]. scaminaci Russo D, Cinelli F, Sarti C, et al. Adhesion to zirconia: a systematic review of current conditioning methods and bonding materials. Dent J (Basel). 2019;7(3):74.