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Influence of Different particle sizes of Aluminum Oxide and Two Primers on Bond Strength to Zirconia

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I. INTRODUCTION

Several all-ceramic systems have been developed in dentistry to meet the increased expectations of patients and dentists for highly aesthetic, biocompatible, and long-lasting restorations. However, early bulk fractures or chippings have led the research community to investigate the mechanical performance of the all-ceramic systems. This overview explores the current knowledge of monolithic and bilayer dental all-ceramic systems, addressing composition and processing mechanisms, laboratory and clinical performance, and possible future trends for all-ceramic materials. [(1)]

CAD/CAM in dentistry is constantly growing and becoming a user- and patient-friendly technology and service using intraoral scanners and laboratory/chairside milling units to manufacture dental restorations and appliances from multiple materials including wax, metals, composite resins, and ceramics. [(2)]

Advances in computer-aided design (CAD) / computer-aided manufacturing (CAM) technologies and their ease of application enabled the development of novel treatment concepts for modern prosthodontics. This recent paradigm shift in fixed prosthodontics from traditional to minimally invasive treatment approaches is evidenced by the clinical long-term success of bonded CAD/CAM glass-ceramic restorations.[(3)]

Zirconia is suggested in many clinical situations due to acceptable biocompatibility, lower price compared with gold restorations, and better appearance than traditional metal ceramic restorations. New translucent monolithic zirconia has been developed to merge strength with improved tooth-colour matching. This work aims to review relevant articles on new translucent zirconia restorative materials. [(4)]

Zirconia ($ZrO2$) based dental ceramics have been considered to be advantageous materials with adequate mechanical properties for the manufacturing of medical devices. Due to its very high compression`n strength of 2000 MPa, $ZrO2$ can resist differing mechanical environments. During the crack propagation on the application of stress on the surface of $ZrO2$, a crystalline modification diminishes the propagation of cracks. [(5)]

To create a strong bond between a resin and ceramic, mechanical and chemical retention are needed. Various surface treatments have been suggested for resin bonding to zirconia including sandblasting, tribochemical silica coating, piranha solution, hydrofluoric acid and laser irradiation. [(6)]

Newly developed translucent zirconia materials have been used for anterior monolithic complete coverage restorations. Surface treatments can improve adhesion, as well as decrease or increase the strength of ceramics. However, information on the influence of surface treatments on the strength of translucent zirconias is sparse.[(7)]

Sandblasting is important to achieve durable bonding to zirconia through micromechanical interlocking between zirconia and resin cements. Sandblasting with $Al2O3$ particles is one of the most simple, functional, and widely used. This procedure cleans and roughens the surface to increase the bonding surface area for mechanical interlocking between the cement and the zirconia surface and the wettability of the zirconia surface for bonding agents. Airborne-particle abrasion may be performed with different sizes of $Al2O3$particles. [(8,9)]

Proper cement selection in fixed prosthesis plays a determinative role in providing long-term serviceability, retention, caries prevention, and patient satisfaction. This study, reviews different luting agent characteristics and their application based on different clinical situations and different types of full coverage restorations. [(10)]

The most commonly used mechanical method involves blasting the surface with alumina

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oxide particles to increase surface area and produce micromechanical retention. (11,12)

Luting cements are a critical, but weak, link between fixed prostheses and their supporting tooth structures. Luting cements have relatively poor physical properties compared to bulk restorative filling materials, but they must fulfill an additional series of requirements such as low film thickness. As they have a wide variety of applications, no single material can be recommended for all clinical situations. (13)

An ideal dental cement has sufficient mechanical properties to resist functional forces over the lifetime of the restoration. In addition, it resists degradation in the oral environment and adheres to the underlying dentin. In order for a restoration to function successfully over many years, the dental cement must be strong enough to resist fracture and cyclical fatigue stresses. (14,15)

The effect of differences in the type of restoration and adhesive resin cement system on the bonding of CAD/CAM ceramic restoration after cyclic loading was examined quantitatively and qualitatively. (16)

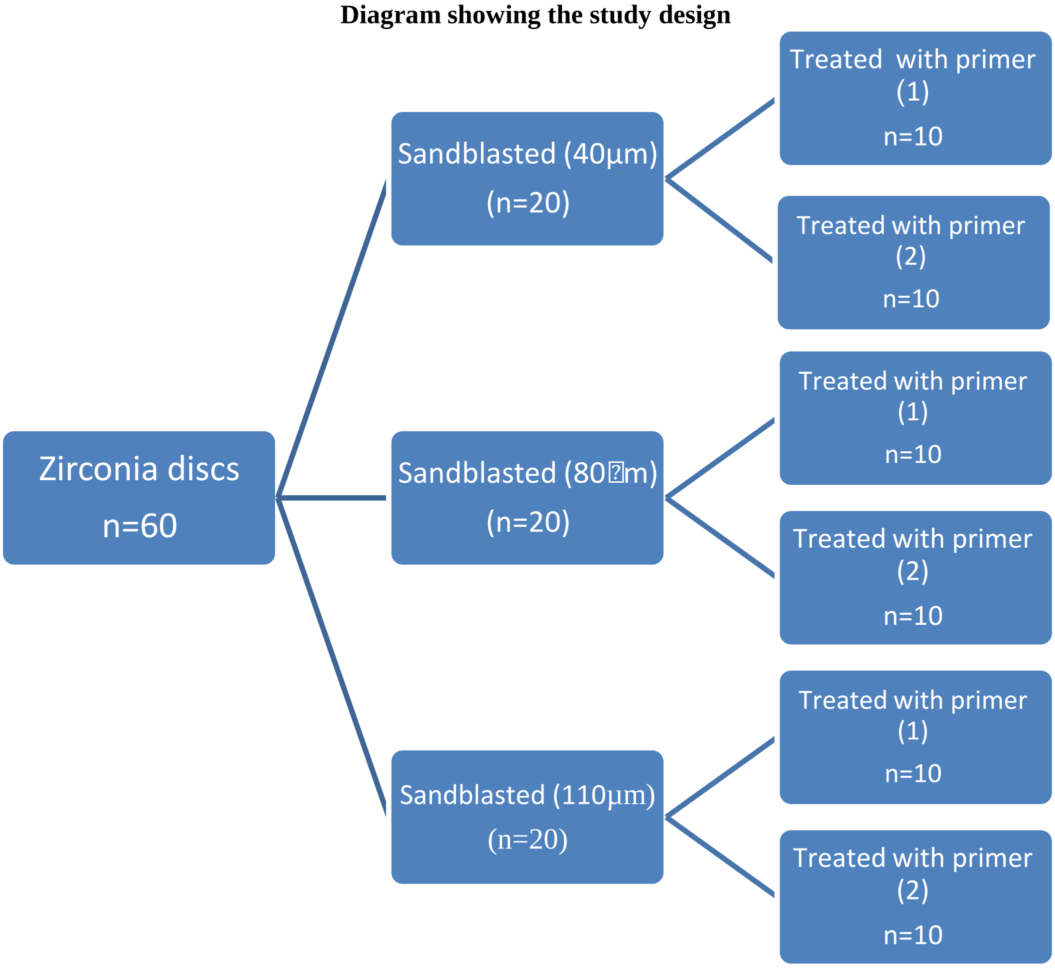
MDP-based and self-adhesive resin cements are recommended for zirconia-based restorations. 10-MDP improves surface wettability and forms cross-linkages with methacrylate groups of the resin cement, as well as siloxane bonds, with the hydroxyl groups of the ceramic surface. (17)

II. AIM OF THE STUDY

This in vitro study will evaluate:

The influence of different particle size of aluminum oxide particles used for sandblasting and different primers as a chemical surface conditioning on bond strength of resin cement to zirconia.

Diagram showing the study design



III. MATERIALS AND METHOD

The following materials will used in this study:

1) Monolithic zirconia ceramic (discs)
2) Two different zirconia primers.
3) Aluminum oxide particles with 3 different sizes
4) Adhesive resin cement.

Methods

A total of 60 zirconia discs will be laboratory fabricated. Discs will be divided into **3 main** groups:
Group **1 :**Discs will be air abraded with Al_2O_3 with particle size **40** nanometer (n=20).
Group **2 :** Discs will be air abraded with Al_2O_3 with particle size **80** nanometer (n=20).
Group **3 :** Discs will be air abraded with Al_2O_3 with particle size **110** nanometer (n=20).
Each main group will be divided into **2 subgroups** (n=10) according to types of primer tobe used:
Primer **1:** (n=10)
Primer **2:** (n=10)

` Standardized sixty light cure composite discs will fabricated and inspected for any defects. Composite discs will be bonded to conditioned zirconia discs. One hour after cementation,bonded specimens will be stored in water bath at 37°C for 3 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 calculated and tabulated for statistical analysis.

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