Assessment of Marginal Adaptation of Monolithic All Ceramic Crowns Using Three Margin Designs and Two Cement Types

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Dedication

This work is dedicated to

My Dear parents

Beloved husband

&

Lovely daughter

My sisters & my brother

Acknowledgment

First and foremost, thanks are due to Allah the beneficent and merciful.

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The rapid development of ceramic systems enabled the treatment of teeth in both the anterior and posterior areas, with the primary objectives of properly restoring form, function and esthetic excellence without the presence of metal.

Among the dental ceramics, both lithium disilicate and zirconium dioxide have emerged as versatile and promising materials because of their biological, mechanical and optical properties, which has certainly accelerated their routine use in Computer aided design/ Computer aided manufacturing (CAD/CAM) technology for different types of prosthetic treatment.

CAD/CAM systems have dramatically enhanced dentistry by providing high-quality restorations. The evolution of current systems and the introduction of new systems demonstrate expanded capabilities, improved quality, and wide range in complexity and application. New materials utilized by this technology also are more esthetic, wear more like enamel, and are strong enough for full crowns and bridges. (1)

Research and development appears to be heading in the directions of improving the strength and esthetics of bilayered restorations and achieving full contour restorations without veneering .Theses are called monolithic restorations which are crowns made of the same ceramic material throughout. (2) This can be achieved utilizing materials such as lithium disilicate glass ceramic and zirconium dioxide.

However, high durability of dental restoration is not only the result of mechanical properties but also marginal fit plays a significant role in the longevity and long-term success of ceramic restorations. [3] A high degree of variation in marginal fit is observed for different ceramic systems. Some of the most important factors to be considered are finish line design, cement type and the material used. [4] [5]

Recently, polycrystalline transparent zirconia has attracted increasing attention because of its unique combination of mechanical and optical properties. [6] It's important that this material will be further investigated in order to get more information about its properties including its marginal accuracy.

Metal ceramic crowns have been used in dentistry since the late 1950s.They are generally indicated when esthetic demands are coupled with the need of maximum strength. Over the last years increasing interest in more esthetically pleasing restorations has prompted the development of all ceramic restorations. [7]

Ceramic restorations are a metal-free alternative due to their excellent esthetic and biocompatibility properties. These materials changed the design and application limits of all-ceramic restorations. [8]

Kelly in 2008 [9] proposed two concepts to help in simplifying the understanding of dental ceramics. First, ceramics fall into three main composition categories: Predominantly glass, particle –filled glass and polycrystalline. Second, ceramics can be considered as a composite material, in which the matrix is a glass that is lightly or heavily filled with crystalline or glass particles. Predominantly glass: have a high content of glass making this type of dental ceramic highly esthetic. This type is the best in mimicking the optical properties of enamel and dentin. Optical effects are controlled by manufactures by adding small amount of filler particles. Another type is particle-filled glass: Filler particles are added to the glass matrix to improve the mechanical properties. Fillers can be crystalline particles of high-melting glasses. Also there is polycrystalline: This type of ceramic contains no glass. Atoms are packed into regular crystalline arrangement making it tougher and less susceptible to crack propagation.

i. Dental Ceramics:

Ceramics are not considered new materials as they were in use more than 10,000 years ago during the Stone Age. [8] They play an integral role in dentistry. Their use in dentistry dates as far back as 1889 when **Land** patented the all-porcelain “jacket” crown. This new type of ceramic crown was introduced in 1900s. The procedure consisted of rebuilding the missing tooth with porcelain covering, or “jacket” as Land called it. The restoration was extensively used after improvements were made by **Spaulding** and publicized by **Capon**. While not known for its strength due to internal microcracking, the porcelain “jacket” crown (PJC) was used extensively until the 1950s. [10]

A resurgence of an all-ceramic restoration came in 1965 with the addition of industrial aluminous porcelain (more than 50%) to feldspathic porcelain manufacturing. **McLean and Hughes** developed this new version of the porcelain jacket crown that had an inner core of aluminous porcelain containing 40% to 50% alumina crystals. [11] Although it had twice the strength of the traditional PJC, it still could be used in the anterior region only (due to its low strength). Its higher opacity was also a major drawback. [12]

Another development in the 1950s by **Corning Glass Works** led to the creation of the castable Dicor® crown system. Glass was strengthened with various forms of mica. The process involved the use of the lost-wax casting technique, which produced a casted glass restoration. Then, this was heat-treated or "cerammed". The ceramming process provided a controlled crystallization of the glass that resulted in the formation and even distribution of small crystals. Examples of different crystalline formations are leucite, fluoromica glass, lithium disilicate, and apatite glass ceramics. [13] The crystal formation increased the strength and toughness of the glass ceramic. The processing difficulties and high incidence of fracture were factors that led to the abandonment of this system. [10]

During this time, a glass-infiltrated ceramic core system was developed. This glass-infused alumina core had a flexural strength of 352 MPa. [14] To increase the translucency and esthetics, Vita replaced the sintered alumina with spinel ($MgAl_2O_4$).Vita also added another variation of the infused core by mixing alumina with zirconium oxide crystals, which increased the flexural strength to 700 MPa. It was intended for posterior crowns and bridges.

In the mid-1990s Nobel Biocare introduced the Procera® AllCeram core, which was the first computer-aided design/computer-aided manufactured (CAD/CAM) substructure. This core consisted of 99.9% alumina to which a feldspathic ceramic was layered.

Parallel to the introduction of infiltrated ceramics, two glass-ceramic compositions were introduced: leucite based (IPS-Empress, IvoclarVivadent, Liechtenstein) and lithium disilicate based (IPS-Empress II, IvoclarVivadent, Liechtenstein). Leucite was first added to feldspathic porcelains to raise the coefficient of thermal expansion to match the metals to which they were fired.