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Review Article

Porcelain Laminate Veneers-Current State of the Art in Aesthetic Dentistry

Ajit Jankar[1], Suresh Kamble[2], Sachin Chaware[3], Shruti Botwe[4], Suraj Sonawane[4] and Madhavi Galale[4]*

[1]Head of Department and PG Guide, Department of Prosthodontics, MIDSR Dental College, Latur, Maharashtra, India

[2]Principal, Department of Prosthodontics, MIDSR Dental College, Latur, Maharashtra, India

[3]Professor and PG Guide, Department of Prosthodontics, MGV's KBH Dental College, Nashik, Maharashtra, India

[4]Post Graduate Student, Department of Prosthodontics, MIDSR Dental College, Latur, Maharashtra, India

***Corresponding Author:** Madhavi Galale, Post Graduate Student, Department of Prosthodontics, MIDSR Dental College, Latur, Maharashtra, India.

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Abstract

Porcelain laminate veneers have been proved to be durable and an aesthetic treatment modality in dental clinics. Dental porcelain has become the most widely used material for the construction of crowns in dentistry because of its excellent esthetic properties and its ability to duplicate the appearance of natural tooth structure. It is a conservative and non-invasive technique treating aesthetic and functional problems in the anterior teeth. Nowadays, innumerable variety of dental ceramics are available for fabricating laminate veneers. It is imperative for clinicians to know and understand the composition and properties of these materials to choose the appropriate option according to clinical situations.

Keywords: *Dental Ceramics; Laminate Veneers; Zirconia Based Ceramic*

Introduction

The prettiest thing anyone can wear is a perfect smile. An ideal smile improves the self-confidence, personality, social life, and has a psychological effect on improving self-image with enhanced self-esteem of the patient [1]. The patient demands for the tooth colour restorations, as well as a more alluring smile, has now passed the boundaries of exclusive practitioners [1]. Based on their strength, longevity, conservative nature, biocompatibility, and aesthetics; veneers have been considered one of the most viable treatment modalities since their introduction in 1983 [2].

A veneer is a layer of tooth-coloured material that is applied to the tooth for aesthetically restoring discolorations. The laminate veneer is a conservative substitute to full coverage for improving the appearance of an anterior tooth. A porcelain laminate veneer is a thin shell of porcelain applied directly to tooth structure [1]. Typically, veneers are built of chairside composite, processed composite, porcelain or cast ceramic materials concerning [3].

At first, to treat the discoloured tooth, using porcelain laminate veneers have been increasingly replaced by more conservative technique, such as bleaching and enamel microabrasion [2].

Now-a-days, patients have high demand for aesthetic restoration and improved smile design with the use of this minimally invasive technique this can be accomplished with new adhesive technologies and ultra-thin ceramic veneer techniques [4].

Porcelain laminate veneers were introduced by Dr. Charles Pincus in Hollywood in the 1930s, to enhance an actor's appearance for closeups in the movie industry [1]. Porcelain laminate veneers (PLVs) have continuously gained popularity among dental practitioners for the conservative restoration of aesthetic anterior teeth [5]. PLV has advanced over the last several decades to become aesthetic dentistry's most popular restoration.

The authors have described uses of different ceramic materials and combination of materials to illustrate different clinical indications.

Indications for ceramic laminate veneers include [6]:

1. Correction of alternations in tooth shape.
2. Morphological anomaly of teeth with microdontia or tooth transposition.
3. Diastemas and/or poor incisal embrasures.
4. Repair of incisal fractures.
5. Extensive anterior dental restorations.
6. Alterations in enamel such as abrasion, attrition, abfraction.
7. tooth discoloration.
8. Rehabilitation of Anterior guidance.

Unfavorable conditions of dental veneers include [4]:

1. Patients with parafunctional habits such as bruxism
2. Edge to edge relation
3. Poor oral hygiene
4. Insufficient enamel.

Materials

A range of material is available in the market to restore aesthetic/functional defects using veneering teeth, and commonly used materials are porcelain, resin composite. Each material type has its distinctive composition, optical characteristics, and fabrication process. Thus, the treatment outcome and longevity will differ according to the material used [4].

Dental ceramics classification

To improve aesthetics in the anterior teeth, a Ceramic laminate veneers can be used. The classification of ceramics is based on the composition, temperature, manufacturing technique and sinterization involved. All ceramics are classified according to sintering temperature, composition, and technique of fabrication involved:

A) Classification of ceramics according to their composition:

1) Glass based ceramics: E.g. Feldspathic porcelain, e-max Press, IPS Empress, and IPS Empress II.
2) Alumina based ceramics: E.g. In-Ceram Alumina, In-Ceram Zirconia, In-Ceram Spinell, Procera All Ceram.
3) Zirconia Based Ceramics.

B) Classification based on processing techniques:

1) Glass-based powder/liquid systems,
2) Pressable blocks of glass-based systems and
3) Computer-aided design/Computer-assessed manufacturing (CAD/CAM) systems.

C) Classification based on type:

1) Feldspathic porcelain,
2) Leucite-reinforced porcelain,
3) Aluminous porcelain; glass-infiltrated alumina, glass-infiltrated zirconia, and glass ceramics.

Glass based ceramics

Feldspathic veneers

Porcelain laminate veneers have undergone significant evolution. Silicon dioxide is silica or quartz, containing a varied proportion of alumina. When these aluminium silicates are found naturally and contain different potassium and sodium, they called feldspars. Feldspars are primarily composed of silicon oxide (60% - 64%) and aluminium oxide (20% - 23%) and are typically modified in different ways to create glass that can then be used in dental restorations [9].

Traditionally fabrication of feldspathic ceramic veneers is, using the layering technique, which incorporates refractory dies used to support the condensed layers of ceramic slurry. Layering techniques have an advantage that the technician has the ability to modify it as required to mimic a natural-looking restoration. The

disadvantage is more time and effort are necessary for precise fitting of restorations. Duplicating the working model with brittle refractory material and removing refractory material after firing the veneers is sensitive procedures [10]. To control these problems of feldspathic porcelain laminate, now a chairside CAD/CAM (computer-aided design/computer-aided manufacturing) machinable feldspathic ceramics are used [11]. In the CAD/CAM procedure, the use of prefabricated blocks having excellent mechanical strength, and they are manufactured under precisely controlled conditions which result in finer crystals with no pores [6].

The advantages of Using feldspathic porcelain:

1) Reproducibility of tooth colour with a thin layer of material,
2) Low laboratory cost,
3) Excellent mechanical retentive characteristics after etching with hydrofluoric acid and the presence of an adequate amount of enamel,
4) Unique bonding characteristics with the use of appropriate silane bonding agents.

Glass ceramics as compared to feldspathic porcelain have improved mechanical fracture resistance, thermal shock insulation is stronger along with increased resistance to corrosion. Mechanical properties are dependent on size and amount of crystals as well as on the interaction of crystals and glass matrix. Glass ceramics may be opaque or translucent which relies on the chemical composition and amount of crystals embedded in the matrix. Addition of evenly distribute filler particles enhances the strength of glassy ceramics, such as leucite and lithium disilicate [12].

Leucite and lithium disilicate

Leucite and lithium disilicate highly filled glass-ceramic restorations preferred to fabricate veneers because of their optical properties, and they are acid sensitive [13]. These materials can be translucent even with high crystalline content, because of the low refractive index of crystals. The shape and volume of the crystals improved the flexure strength of glass-based ceramics. Glass ceramics may be opaque or translucent depending on the chemical composition and amount of crystals embedded in the matrix. They have improved flexure strength which is depends upon the shape and volume of the crystals. The flexural resistance of leucite reinforced ceramics and lithium dioxide are respectively 160 - 300 MPa and 320 - 450 MPa.

In heat pressing method, the restoration is first waxed-up and invested, then sintered ceramic is used to make ingot which is softened and pressed into a mould under pressure. Staining can be done to ingot shade to achieve better aesthetics.

In leucite reinforced glass-ceramics (IPS Empress-Ivoclar Vivadent), the leucite crystals compose 50% - 55% of the material and have a refractive index that is very close to feldspathic ceramics, besides, it has a faster rate of etching than base glass, this feature for resin cement to enter creating a stronger micromechanical bond.

IPS ProCAD (Ivoclar Vivadent) is a leucite reinforced ceramic and is similar to IPS Empress with finer particle size. It was introduced in 1998 and used with the CEREC inLab system and#40; Sirona Dental Systems, Bensheim, Germanyand#41; and these are available in different shades including bleached shade and aesthetic block line.

Lithium disilicate reinforced ceramics (IPS Empress II- Ivoclar Vivadent) are true glass-ceramics contenting 70% of lithium disilicate crystal.

IPS e-max press (Ivoclar Vivadent), a lithium disilicate glass ceramic was introduced in 2005. It had superior physical properties and improved transluceny [14].

Alumina based ceramics

Alumina based ceramics: In-Ceram porcelains and Procera All Ceram.

In-ceram porcelain

For fabrication of In Ceram porcelain reinforced core material is built upon refractory die. Slip casting technique is utilized for this purpose. During the firing process die shrinks and is withdrawn from its core.

In-ceram alumina

In-Ceram alumina was introduced in 1989, which is composed of 85% aluminium oxide particles having a diameter of 2 - 5 µm. This high alumina content provides flexural resistance in the range of 400 - 600 MPa. As compared to leucite reinforced glass ceramics and conventional feldspathic porcelain, In-Ceram alumina ceramics higher strength and fracture toughness and whereas they show a low translucency than glass-based ceramics [15].

In-ceram zirconia

In Ceram Zirconia is composed of 67% aluminium oxide, and 33% partially stabilized zirconium oxide and is a modification of the original In-Ceram alumina [16]. Zirconia modified alumina ceramic compared to In-Ceram alumina has higher fracture toughness and flexural resistance. In-ceram Zirconia possess an opaque core.

Procera all-ceram

In 1993, Procera was developed by Andersson and Oden. It contains 99.9% high purity aluminium oxide and copings coated with conventional aluminium ceramic [17]. Procera shows high strength as compared to glass and In-Ceram ceramics, whereas shows less than Zirconia-based ceramics.

Zirconia based ceramics

Zirconia based ceramics are polycrystalline material having no glass. The atoms of polycrystalline ceramic are packed into regular crystalline arrays which becomes more resistant to crack as compared to less dense and irregular network found in glasses. So polycrystalline ceramics compare to than glass-based ceramics are harder and stronger [18].

Zirconia based ceramics has three forms, at its melting point of 2680˚C, the cubic structure exists and transforms into the tetragonal phase below 2370˚C, transformation from tetragonal to monoclinic phase occurs below 1170˚C and accompanied by a 3% - 5% volume expansion which causes high internal stresses [19].

Yttrium oxide (Y_2O_3 3% mol) added to control the volume expansion and to stabilize the zirconia in the tetragonal phase at room temperature. This partially stabilized zirconia has high initial flexural strength and fracture toughness.20 Under tensile forces, the tetragonal phase transforms into a monoclinic phase with an associated 3% - 5% localized expansion, this volume increase creates compressive strength at the crack tip that counteracts the external tensile stresses. This mechanism is known as transformation toughening and which retards crack propagation [20].

Shade and material choice for ceramic laminate veneers

For the restoration of the anterior teeth, the most critical factor is the shade of the replaced tooth should match that of the adjacent tooth. The amount of reflection and scattering of light affects the translucency of ceramic material and influences the shade of the final laminate veneer restoration [15]. The amount of light that is absorbed, transmitted, and reflected depends on the chemical nature and size of the particles within the core material.

Translucency is a natural phenomenon that varies among ceramics. Clinicians usually face challenges in shade selection and reproducing optical properties similar to those of the adjacent natural teeth with high translucency, especially when the prepared teeth are severely discoloured. As translucency has increased with lighter ceramics, underlying dark tooth structure is difficult to mask and hence colour match in porcelain laminate veneers is more complicated [6].

Summary and Conclusion

All ceramic restorations have been used extensively to simulate natural tooth structure and they have mechanical properties which have expanded their clinical application. Therefore, it can be concluded that, significant aesthetic and functional corrections can be attained even in complex cases of laminate veneers with careful treatment planning, advances in material and fabrication techniques.

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