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All Ceramic System - A Review

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Abstract: Dental ceramic are the most natural appearing replacement material for missing tooth substance. Many dental materials are used in dentistry but all ceramic have come –up with new growth. It has many qualities for its use but its esthetic appearance made it leader among other dental material. As this the fastest growing material still it has certain shortcomings i.e lack of strength, brittleness, crack propagation and wear of opposite natural teeth. Research is being done to combat all these shortcomings.

Keywords: Conventional ceramics, Castable ceramics, Machinable ceramics, Pressable ceramics, Infiltrated ceramics.

Introduction

Ceramics are thought to be the first materials made by man . Early fabrication of ceramic articles dates back to 23,000 BC. Historically, three basic types of ceramic materials were developed; Earthenware, Stoneware, & Whiteware. Ceramics are also considered to be the earliest group of inorganic materials to be structurally modified by man. In attempts to meet requirements of dental materials and improve their strength and toughness, many new materials and technique are being developed.

Historical perspective of porcelain

The history of porcelain as dental material goes back nearly 200 years. Pirre Fauchard was the first one to use porcelain as dental material in 1728.

1820-Porcelain denture teeth were introduced, which replaced ivory/natural denture teeth in U.S.A.

1884-Dr.Charles H. Land pioneered the development of the first glass furnace for fusing porcelain.

1887-Dr.C.H.land of Detroit developed the first all-porcelain jacket crown using the Platinum Foil Matrix technique.

1900- Brewster introduced porcelain inlays for clinical use.

1985-First CAD/CAM crown was publically milled and installed in the mouth.

1985-Hobo and Kyocera developed a castable glass-ceramic.

1992-The Celay copy-milling system, became commercially available.

Porcelain is the most natural appearing synthetic replacement material for missing tooth substance, available in an extensive range of shades and translucencies for achieving life like results. But its esthetic appearance was compromised when it was fused to metal substrate in effort to strengthen the porcelain. In addition some patients have allergic reaction to various metals. These all drawbacks together prompted the development of new all ceramic system that do not require metal for strength yet have high strength and precision fit.

The term" all ceramic" refer to - any restorative material composed exclusively of ceramic, such as feldspathic porcelain, glass ceramic , alumina core system and certain combination of these system.

Advantage of all ceramic restoration- main advantages of all ceramic is most natural appearing. As it is not fused to metal problems like, allergies, yellowness of tooth, dark line visibility, corrosion are eliminated. Other qualities like Inertness, increased translucency, bio-compatibility, low temperature and electrical conductivity.

Tooth preparation for all ceramic restoration-the accepted design indicated by manufacturers for ceramic jacket crown is-the 90°full shoulder with a rounded gingival- axial line angle or a deep chamfer. Tooth reduction is 1.0 to 1.5 mm for axial surface and 1.5 to 2.0 mm for incisal edge or occlusal surface. Specific margin designs and other recommendation for tooth prepration should be followed for each of these materials.

Currently available all-ceramic can be broadly categorized according to their method of fabrication Conventional (powder-slurry) ceramics

- Castable ceramics
- Machinable ceramics
- Pressable ceramics
- Infiltrated ceramics

Conventional- Dental porcelain restorations are made by mixing ceramic powders of selected shades with distilled water or a special liquid i.e binder to form a plastic mass. This is condensed either directly on a refractory die or a matrix and shaped into the desired form, then fused in a furnace by firing to develop a translucent tooth like material.
Fabrication of castable ceramic involve mainly two steps-

Casting – The wax pattern of the proposed restoration made on the model/die is invested in castable ceramic investment in a double-line casting ring and burned out in a conventional burnout. Glass ingots of castable ceramic material is placed in a special zirconia crucible and centrifugally cast in casting machine made especially for all ceramic materials.

Ceramming- The cast glass material is subjected to a single-step heat treatment called as Ceramming to produce controlled crystallization. In this procedure transparent fragile casting is embedded in castable ceramic embedment material and placed in a Ceramming tray.

Machinable ceramics-machinable ceramic system for dental restoration consist of digital systems (CAD/CAM) system. Three steps for fabrication are:

3-dimensional surface scanning

CAD-Modelling of the restoration and fabrication of restoration.

Flow chart showing sequential events occurring during cad/cam technique of fabrication:

The cavity preparation is scanned stereo-photogrammetrically, by 3D camera
↓
The small microprocessor unit stores the three dimensional pattern depicted on the screen
↓
The video display serves as a format for the necessary manual construction via an electric signal
↓
Microprocessor develops the final three-dimensional restoration from two dimension
↓
The processing unit automatically deletes data beyond the margins of preparation
↓
The electronic information is transferred numerically to the miniature milling device
↓
Milling device generates a precision fitting restoration from a standard ceramic block.

Pressable ceramic-The wax pattern is invested in special investment material. Following burn out the crucible former is placed into the automated furnace. The ceramic ingot of the selected dentinal shade is placed under the plunger and

preheated. After preheating the plunger presses the ceramic block into mold. After this veneering is done. Infiltrated ceramic- A slurry of densely packed (70 to 80%) Al_2O_3 is applied and sintered to a refractory die at 1120°C for 10 hrs. This process produces a porous skeleton of alumina particles, which is infiltrated with lanthanum glass in a second firing at 1100°C for 4 hrs to eliminate porosity and increase strength.

Conclusion

In the earlier time when wood, ivory, natural teeth were used for replacement of natural teeth. From then constant research are being done to develop such material which can mimic tooth qualities. Recent material, technical and clinical innovation in restorative dentistry made such dreams come true.

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