

Type of the Paper (Mini-Review Article) Introduction to Optical Properties of Dental Ceramics

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Abstract: Shade matching is a critical problem in replacing natural teeth. Translucency is another critical property of dental ceramics. In order to mimic the optical properties of human enamel, opalescence is often desirable. Dental enamel also exhibits fluorescence.

Keywords: Optical, ceramics, shade matching.

Shade matching is a critical problem in replacing natural teeth. The shades of commercial premixed dental porcelain powders are in the yellow to yellow-red range. Because the range of shades of natural teeth is much greater than the range available in a kit of premixed porcelains, modifier porcelains are also supplied for adjustments. These modifiers are strongly pigmented porcelains usually supplied in blue, yellow, pink, orange, brown, and gray. Extrinsic surface staining, another way of changing the appearance of a ceramic crown, involves the application of highly pigmented glazes. The main disadvantages of surface staining are: a lowered durability (a result of solubility) and the reduction of translucency ⁽¹⁾.

Translucency is another critical property of dental ceramics. In case of metal-ceramic restorations, the ceramic is built in three main layers, the translucency of each differs considerably: opaque, dentin (body), and enamel (incisal) porcelains. Opaque porcelains have very low translucency, allowing them to mask metal substructure surfaces. Enamel porcelains have the highest values of translucency. The translucency of materials for all-ceramic restorations varies with the nature of the reinforcing crystalline phase. The match between the refractive indexes of the crystalline phase and glassy matrix is an important factor for controlling the translucency of the porcelain. Increasing the amount of crystalline phase in many high strength ceramics may decrease the translucency and increase the opacity. Thus, these materials are used in all ceramic restorations as a core material and have to be veneered with a more translucent ceramic material ⁽¹⁾.

In order to mimic the optical properties of human enamel, opalescence is often desirable. Opalescence is a form of scattering and occurs when the crystal size is equal or smaller than the wavelength of light. In reflected light, the shorter blue-violet wavelengths are transmitted, whereas in transmitted light, the longer red-orange wavelengths are transmitted through the porcelain ⁽²⁾.

Dental enamel also exhibits fluorescence. This characteristic is achieved in dental porcelains by adding rare earth oxides (such as cerium oxide). Because the outer layers of a ceramic crown are translucent, the apparent color is affected by reflectance from the inner opaque or core ceramic ⁽²⁾.

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