

Ceramic restorations-innovative systems

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Dental ceramic usually consists of an amorphous, transparent glass phase, in which crystalline mineral particles are dispersed on the one hand for scattering the light giving it a milky appearance, and on the other hand to increase the strength. For special purposes, e.g. to obtain an extremely high strength for dental restorations, pure oxide ceramics e.g. aluminium oxide ceramic without glass phase can also be used.

Full ceramics is a collective term for mineral, tooth-coloured restorations without metal substructures, which can be produced by

- sintering of ceramic powder.
- plastic shaping from prefabricated glassy or ceramic blocks in a molten or viscous state.
- machining blanks with and without subsequent sintering,
- glass infiltration of presintered structures, or also
- by a combination of several of the above-mentioned processes.

The most important factor is the material strength. This is expressed in the two material properties flexural strength and fracture toughness.

For ceramics which are used without a metal support, it is extremely important that

-there are as few micro-cracks as possible, not only on the surface (as for determining the flexural strength), but also in the interior of the material.

-mechanisms are built into the material, whereby the crack propagation is hindered (just as for example small knots in the wood are an obstacle to chopping logs).

This is performed by particle strengthening in glass ceramics (e.g. EMPRESS) or transformation strengthening with zirconium oxide (e.g. In-Ceram Zirconia).

The goals to be achieved in manufacturing dental restorations by computer-aided design(CAD) and machining(CAM) differ

- in the method of recording the tooth preparation (mechanically by scanning or optically using video or laser techniques, directly in the patient's mouth or indirectly on a model),
- in the area of indications(inlays/onlays, crowns or bridges),
- in the degree of finishing (with or without occlusal surface design, copings or complete crowns),

-in the choice of materials used (glass or oxide ceramics).

The introduction of various systems, e.g. the sophia(Duret et al. 1988) and DentiCAD System (Rekow 1991) has failed up till now as a consequence of their developers' high demand of producing every type of dental restoration in a perfect design for clinical use.

In contrast, promising - and partly already successful - developments are the Cerec system(Mormann et al. 1987, Mormann and Krejci 1992), the DCS system (Strupowsky 1994, Graber and Besimo 1994), the DECIM system (Kappert et al, -in preparation) and PROCERA technique(Gottlander et al. 1994), which limited their application to realistic aims in terms of dental processing and the choice of materials used.

The most relevant systems will be described and various experimental results on the strength of all ceramic crowns and bridges will be presented.