



1 From the block to the final veneer

GLASS CERAMICS ENABLE FLEXIBLE DENTAL RESTORATION

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Glass ceramics as restorative material

In many cases glass ceramics are very suitable for dental restoration. The translucency (partial transparency) and the mechanical properties (e. g. strength and polishing behaviour) can be adjusted via the crystalline components like crystal size and phase fractions. In comparison to pure glass the chemical resistance is even better – an important aspect for its use in oral environment.

Chair site production

For CAD/CAM applications another material's property is essential: In an intermediate state during the crystallization process the material can be mechanically machined easily. Afterwards the material can be transformed in just one annealing step to the final high-tensile glass ceramic.

State of the art

Virtually all companies active in the field of dental supplies provide CAD/CAM systems for all-ceramic restorations. The big advantage of this method is that in a single session – the so called chair-side technique – a high-quality and individually customized dental product can be manufactured during the treatment of the patient. Compared to the classic two- or multi-step procedure with temporaries this leads to an eminent efficiency gain saving a great amount of time and costs for both the patient and the dentist.

The chair-side technique consists of the following steps:

- Recording of the tooth or the teeth to be restored with an intraoral camera
- Computation and processing of a restoration model with computer (CAD)



- Selection of a blank with respect to size and colour of the existing teeth
- Milling out the restoration of the blank with a milling/grinding unit, e. g. CEREC (CAD)
- Thermal after-treatment in less than 30 minutes to increase the strength
- Gluing/cementing of the restoration (crowns, inlays, onlays, veneers, etc.)

Prior to gluing the dental crown/bridge additional veneering materials can be added which can be tempered to achieve a certain colour gradient according to the patient's wishes.

The new material

In collaboration with DeguDent GmbH (Hannau) and VITA Zahnfabrik H. Rauter GmbH & Co. KG (Bad Säckingen) the Fraunhofer ISC has developed a novel glass ceramic base system and an adapted production method.

The patented new glass ceramic base system has an excellent translucency, high chemical resistance and great strength. With the current available dental CAM systems the material can be processed within a wide range of crystallization parameters. The base material converts very quickly into the final state and retains its shape.

Furthermore, the colouring can be easily adjusted and finally processed by the dentist (e. g. polishing).

The competence unit Glass and Mineral Materials at Fraunhofer ISC developed the new material as well as the production process in accordance with medical guidelines and required QM measures.

Both industry partners introduced the new material into the market under the trade names Suprinity® and Celtra®.

Material properties

The new glass ceramics have higher glass matrix portions than glass ceramics containing no or only small amounts of ZrO₂ and thereby show excellent optical properties. Despite the relatively high proportion of glass phase, the newly developed glass ceramics show at least equal chemical resistance whereas the mechanical properties are significantly superior to previous available products. As a characteristic of mechanical stability in dental applications the standardized 3-point flexural strength is given. The lithium silicate glass ceramics reinforced with zirconium oxide (ZLS) exhibit considerably higher flexural strengths (up to 450-500 MPa) than common products. Due to the high values aesthetically superi-

or glass ceramics can be applied for molar bridges (i. e. in the molar region, with the highest requirements for strength) for the first time.

What's more, the common 2-step crystallization process is no longer necessary. Previous CAD/CAM materials are only available with a flexural strength up to 200 MPa and require a more than 30 minutes lasting thermal treatment at about 800 °C and higher to get enough flexural strength (sintering or crystallization of (glass) ceramics).

Due to the very fine texture and the high glass matrix portion the final crystallized product can be processed with common CAM units despite its flexural strength up to 500 MPa (!). The new glass ceramic can be applied with conventional 2-step method as well as with the single step process. This is a tremendous advantage for an efficient dental treatment.