

# HYBRID CERAMICS FOR CHAIRSIDE RESTORATIONS

RESTORATIVE

Initial experience with SHOFU Block HC, a CAD/CAM material for chairside restorations providing efficient fabrication of single-tooth restorations in one appointment

✉ ILA DAVARPANAH

The last 30 years have seen tremendous advances in CAD/CAM dental restorations, making this technology increasingly popular in daily practice. Above all, improvements in intraoral cameras, leading to powder-free scans, true-colour displays, and smaller camera heads, have substantially simplified the clinical handling of CAD/CAM systems.

The latest software solutions allow dental professionals not only to operate these systems intuitively after a relatively short learning curve, but also to use largely automatic restoration designs <sup>1</sup>. All these aspects have made chairside restorations more efficient in terms of data collection and design procedures. Further innovations have been achieved in the field of CAD/CAM restorative materials. Two directions of development can be observed here.

One approach has been to develop new high-strength ceramics minimising the risk of material-related restoration failure. Both high-strength glass ceramics (lithium disilicate, zirconia-reinforced lithium silicate) and partially stabilised zirconia have gained acceptance. However, due to their increased strength, these materials usually need to be first milled in a pre-sintered state and then finally sintered in a separate firing process giving them their definitive strength. These processes require additional equipment (furnaces) in dental

practices and make restorations more time-consuming <sup>2</sup>.

Another approach has been to combine ceramics and polymers into a new material type known as hybrid ceramics <sup>2,3</sup>. This group of materials is also described as CAD/CAM high-performance polymers. The materials (e.g. SHOFU Block HC, SHOFU Dental GmbH, Ratingen, Germany; Lava Ultimate, 3M Espe, Seefeld, Germany; Cerasmart, GC, Bad Homburg, Germany) are made by embedding nano-ceramic particles in a very hard polymer matrix <sup>4</sup>.

The industrial polymerisation process of this matrix, using both light and heat, significantly improves material properties. The mechanical properties of hybrid ceramics range between those of traditional glass ceramics and light-cured composite materials <sup>2-4</sup>. Their filler loads vary between approx. 60 and 80 per cent by weight, depending on the manufacturer, and their flexural strengths have been found to be 120 to 200 MPa in various studies <sup>5,6</sup>. Their moduli of elasticity range from 9 to 14.5 GPa, coming relatively close to the E-modulus of natural dentin (17-29 GPa) <sup>2-7</sup>.

A special hybrid material has been developed by infiltrating a fine-structure ceramic network with an acrylate polymer mixture (Vita Enamic, Vita Zahnfabrik, Bad Säckingen, Germany). This material, which is also described as a hybrid ceramic, has



Ila Davarpanah is a dentist from Hanau in Germany

## ● The low hardness of hybrid ceramics makes milling easier and processing times much shorter ●

filler loads of up to 86 per cent by weight, leading to a flexural strength of 140 MPa and a modulus of elasticity of 28 GPa<sup>5-7</sup>.

Since the modulus of elasticity of hybrid ceramics comes closer to that of natural dentin, restorations can be expected to distribute stresses more homogeneously<sup>2</sup>. Besides, a “damping effect” has been postulated for hybrid ceramics, thanks to the favourable combination of a dentin-like modulus of elasticity and lower hardness<sup>4</sup>. Moreover, the low hardness and very good polishability of these materials clearly reduce antagonist abrasion, as compared to traditional ceramics<sup>3,4,8,9</sup>. And the low hardness of hybrid ceramics also makes milling easier and processing times much shorter, as compared to ceramics.

What is more, the flexibility of hybrid ceramics is considerably higher than that of traditional ceramics, reducing the risk of marginal chipping during the milling process. This is particularly beneficial when restorations with thin parts have to be made<sup>2</sup>. Besides, it helps to greatly reduce tool wear. Tools may need to be changed after 15-20 units when milling ceramics, whereas more than 50 restorations can be made with one set of instruments when milling hybrid ceramics<sup>2-4</sup>. Like glass ceramics, hybrid materials also show a chameleon effect facilitating shade matching. And the shades of hybrid-ceramic restorations can be relatively easily and quickly individualised using light-cured stains.

Hybrid ceramics are particularly suitable for chairside restorations, since they combine favourable mechanical properties with quick milling and polishing, so that processing times are short<sup>2-4</sup>. On the basis of the in-vitro data currently available, hybrid ceramics are recommended for use as inlay, partial crown and veneer materials. Besides, all hybrid ceramics on the market, except Lava Ultimate, are indicated for anterior and posterior crowns. At present, all hybrid ceramics require adhesive cementation, after surface conditioning by either sandblasting at reduced pressures (1-1.5 bar) or etching with hydrofluoric acid. Irrespective of the conditioning method used, a chemical primer (silane) needs to be applied<sup>4,10</sup>.

### Case report

This case report describes the chairside production of a posterior crown with the aid of the Cerec system (Omnica + Cerec MC XL, Sirona Dental Systems GmbH, Bensheim, Germany), using the hybrid-ceramic material SHOFU Block HC (SHOFU Dental GmbH, Ratingen, Germany).

A 38-year-old male patient presented for restoration of tooth 46 with a crown after successful endodontic

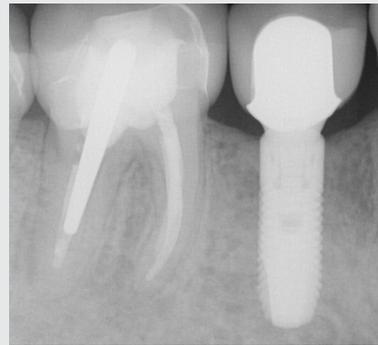


FIGURE 1 – Post-endodontic restoration with an adhesively cemented zirconia post (CeraPost, Komet Dental, Lemgo, Germany)



FIGURE 2a – Placement of Adstringent Retraction Paste (3M Espe, Seefeld, Germany) prior to preparation



FIGURE 2b – Placement of Adstringent Retraction Paste (3M Espe, Seefeld, Germany) prior to preparation

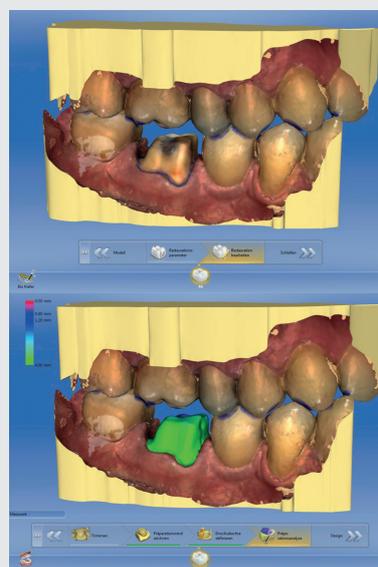


FIGURE 3 – Assignment of partial jaw scans through lateral scan and preparation analysis

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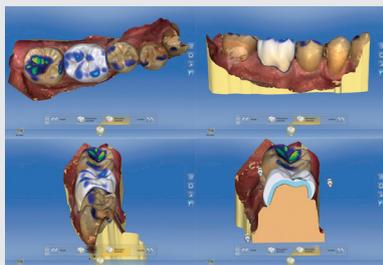


FIGURE 4 –  
Restoration design  
using the Cerec  
software (Version  
4.4.4)

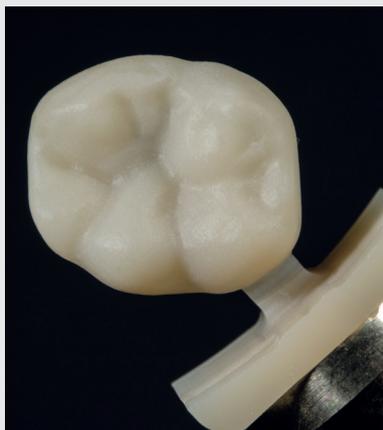


FIGURE 5 –  
Molar crown milled  
from the hybrid-  
ceramic material  
SHOFU Block HC  
(SHOFU Dental,  
Ratingen, Germany)

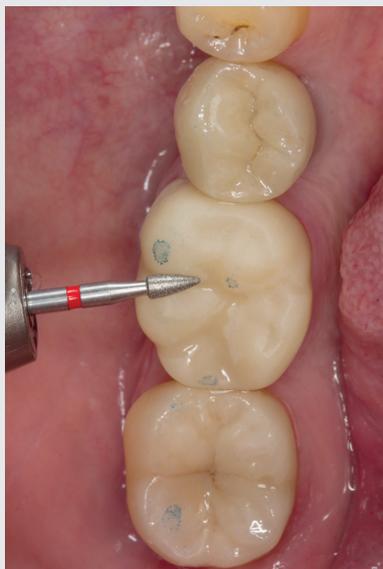


FIGURE 6 –  
Try-in and occlusal  
adjustment of the  
restoration

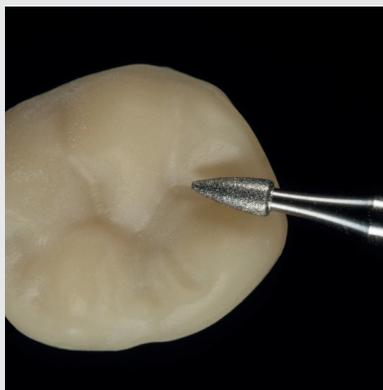


FIGURE 7 –  
Finishing the  
occlusal fissure  
relief with a suitable  
fine-grit diamond  
bur (8390.104.016,  
Komet Dental,  
Lemgo, Germany)

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treatment. It was decided to fabricate a monolithic crown chairside with the Cerec system. The material used was SHOFU Block HC, a hybrid ceramic which has been an option for the Cerec software since its Update 4.4.3. This restorative is available with matching cementation and polishing systems.

After post-endodontic restoration with an adhesively cemented post (CeraPost, Komet Dental, Lemgo, Germany) and an adhesive core build-up (CoreXflow, Dentsply Sirona Restoratives, Konstanz, Germany) (Fig 1), a circular chamfer was prepared (1.0 mm reduction), and the occlusal surface was reduced by 1.5 mm. The transitions between axial and occlusal surfaces were rounded, to suit this material.

For digital impression with a powder-free scanning system (Cerec Omnicam, Sirona Dental Systems GmbH, Bensheim, Germany), Adstringent Retraction Paste (3M Espe, Seefeld, Germany) was applied around the prepared tooth to temporarily displace the soft tissues and effectively control the bleeding. The paste was thoroughly rinsed off with water after being left undisturbed for three minutes, and the preparation was carefully dried (Fig 2a-b). Complete bleeding control and soft tissue displacement allowed us to intraorally scan the lower jaw. This was followed by data collection in the first quadrant and lateral scanning for assignment of the two partial jaw scans (Fig 3). After automatic assignment of the three scans to a virtual model set, the preparation margin was marked, and the insertion path of the restoration was determined.

The preparation analysis confirmed sufficient material reduction, so that we proceeded to the next step, i.e. restoration design (Fig 4). A minimum material thickness of 1 mm was specified as a restoration parameter. The occlusal milling offset was adjusted to  $-100\ \mu\text{m}$ , and marginal reinforcement was reduced to  $40\ \mu\text{m}$ . For traditional ceramics,  $70\ \mu\text{m}$  would be recommended, in order to prevent any marginal chipping. However, since SHOFU Block HC is easier to mill and more flexible, this value could be reduced. The reduction of marginal reinforcement decreases the risk of over-contouring the restoration and the effort needed to finish and polish it after milling.

The design suggestion required only minimal corrections at the mesial and distal marginal ridges, plus corrections of the lingual and buccal cusp tip heights. Finally, the occlusal and interproximal contacts were corrected. Ideally, all contact surfaces should appear in light blue. Based on clinical experience, intraoral adjustments are minimised when using these digital design parameters.

The material used, SHOFU Block HC, is available in two sizes; each size comes in six low-translucency shades

● The new group of hybrid-ceramic materials allows dentists to efficiently fabricate single-tooth restorations in a single appointment ●

(W2-LT, A1-LT, A2-LT, A3-LT, A3.5-LT, B3-LT), three high-translucency shades (A1-HT, A2-HT, A3-HT), and two enamel shades, OC (Occlusal) and 59 (Incisal). In this case, an A3.5-LT block was selected to match the shade of the adjacent teeth as accurately as possible.

The crown was made using a wet milling unit (Cerec MC XL), set to the 'fine' mode. It was milled in just under 10 minutes and then prepared for the first intraoral try-in (Fig 5). The only step required was to remove the holding pin from the crown with a rotary diamond bur (835.104.014, Komet Dental, Lemgo, Germany). The crown was tried in, and since no further adjustment of the interproximal contact points was needed, we directly checked the occlusal contacts. After the patient had marked the occlusal contacts by carefully biting on articulating foil, the necessary adjustments were done with a fine-grit diamond bur (8390.314.016, Komet Dental) (Fig 6).

The adjusted restoration was then finished and polished. After finishing the fissures with a suitable diamond bur (8390.105.016, Komet Dental, Lemgo, Germany) (Fig 7), 'Brownie' and 'Greenie' silicone polishers (Amalgam Polishing Kit, SHOFU Dental GmbH, Ratingen, Germany) were used at speeds of 5,000-7,000 rpm (Fig 8a-b). Finally, diamond polishing paste (Dura-Polish DIA, SHOFU Dental GmbH) was used with a brush at a maximum speed of 15,000 rpm to achieve a perfect high-gloss polish (Fig 9).

Restoration shades can be individualised with light-cured composite stains. Surfaces to be characterised are first roughened with fine-grit diamond burs and then cleaned (alcohol/steam cleaner); after applying a special primer (SHOFU HC Primer), suitable stains (LiteArt, SHOFU Dental, Ratingen, Germany) can be used for characterisation. Before cementation, SHOFU Block HC restorations should be thoroughly cleaned using ultrasonic or steam cleaners. Restorations made of hybrid ceramics always require adhesive cementation.

Conditioning can be done by sandblasting with alumina (30-50 µm) at reduced pressures (1.0-1.5 bar) or etching with hydrofluoric acid (5 per cent, for 30 seconds). Irrespective of the conditioning method used, a chemical primer (HC Primer, SHOFU Dental, Ratingen, Germany) needs to be applied (Fig 10). The product of choice for adhesive cementation of crowns is a resin cement system with a self-etch bonding agent (ResiCem, SHOFU Dental GmbH, Ratingen, Germany).

The use of a self-etch bonding agent eliminates phosphoric acid etching and subsequent rinsing. This is particularly beneficial in the case of crown preparations with equigingival or subgingival margins, where etching and rinsing may cause renewed bleeding. When using self-etch bonding agents, crown cementation can begin directly after the bonding step. And, usually, relative isolation should be sufficient for cementation. This is very important, because absolute isolation of full crown preparations with a rubber

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## HC SHOFU Block HC



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FIGURE 8a – Polishing the restoration with ‘Brownies’ and ‘Greenies’ (Amalgam Polishing Kit, SHOFU Dental, Ratingen, Germany)

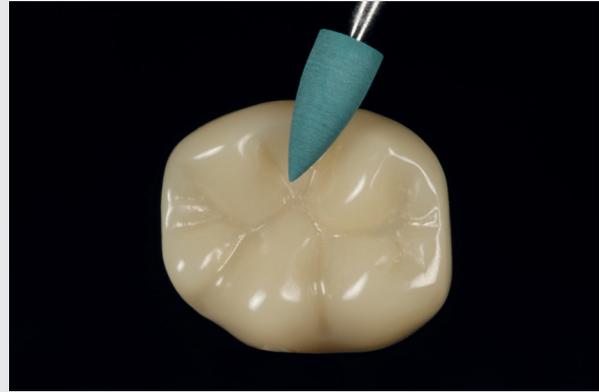


FIGURE 8b – Polishing the restoration with ‘Brownies’ and ‘Greenies’ (Amalgam Polishing Kit, SHOFU Dental, Ratingen, Germany)



FIGURE 9 – High-gloss polishing with diamond paste (Dura-Polish DIA, SHOFU Dental, Ratingen, Germany)



FIGURE 10 – Surface conditioning by roughening (sandblasting/etching) and application of a special primer (HC Primer, SHOFU Dental, Ratingen, Germany)

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dam is quite difficult, as compared to partial crown and inlay preparations.

Prior to adhesive cementation with ResiCem, a retraction cord was placed to avoid pressing any excess cement into the sulcus. Then the tooth was cleaned with a fluoride-free paste and dried. The components of the self-etch bonding system (Primers A and B) were mixed at a ratio of 1:1 and applied to the prepared tooth surfaces. Finally, the dual-cure cement ResiCem was applied to the inner surface of the crown directly from the automix syringe.

The restoration was seated and checked for correct fit, and the excess cement was tack-cured from the lingual and vestibular aspects for two to three seconds. This led to a rubber-like consistency facilitating excess removal. After removing all the excess cement and checking the interproximal spaces for patency, the restoration was fully light-cured from the lingual/occlusal and vestibular aspects for 40 seconds each. If the final inspection had shown any need for further occlusal adjustments, fine-grit diamonds, ‘Brownies’ and ‘Greenies’ could have been used again for this purpose (Fig 11).

#### Discussion

Thanks to favourable properties, such as good millability and polishability, the new group of hybrid-ceramic materials allows dentists to efficiently fabricate single-tooth restorations in only one appointment. Additional benefits include dentin-like elasticity and low antagonist abrasion. Current in-vitro data regarding mechanical characteristics, abrasion behaviour and discoloration tendency seem to be promising. However, it should also be taken into account that there is still a lack of long-term clinical data, which would be indispensable to any further scientific assessment of this innovative material category.

So, for the time being, it will be absolutely necessary to observe the restricted indications for use given by the manufacturers, and also the recommended preparation methods and minimum material thicknesses, when using hybrid ceramics in clinical practice. Besides, the use of hybrid ceramics for single-tooth restorations can be advised only in combination with a suitable adhesive cementation system.

#### Credit

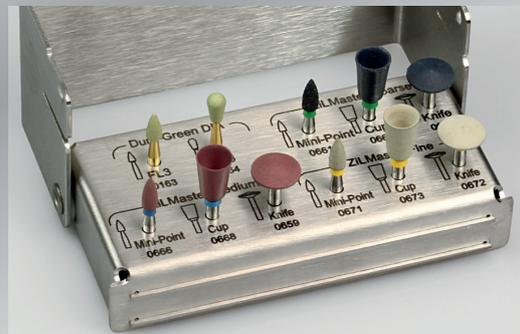
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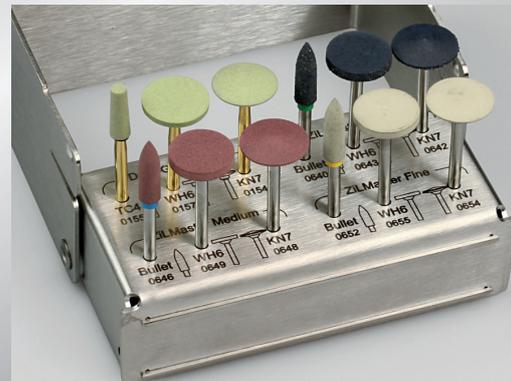
FIGURE 11 – Crown made of the hybrid-ceramic material SHOFU Block HC (SHOFU Dental, Ratingen, Germany) after shade individualisation and adhesive cementation

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