Gold standard for chairside restorations
Highly esthetic and high-strength monolithic IPS e.max CAD restorations

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IPS e.max CAD has had a lasting impact on the dental market over the last decade. The clinical reliability of hardly any other dental material has been so well documented. Highly esthetic and high-strength monolithic IPS e.max CAD restorations have become an alternative to metal ceramics and offer a comparable survival rate.

Introduction

As dental CAD/CAM systems have become established in dentistry, the vision of producing indirect restorations in the dental practice has become reality. An intraoral 3D-camera for digital impression-taking, an intuitive design software and a numerically controlled milling machine are the technologies that enable restorations to be created on-site in a short time compared to manufacturing in the dental lab. In addition to the time advantage, the digital method has also the benefit of saving resources, such as impression materials. Furthermore, the need for temporary restorations is eliminated.

Requirements placed on materials for chairside manufacturing

The technical prerequisites go hand in glove with materials that are suited for chairside manufacturing. Such materials should be strong enough to withstand a lifetime of use. However, very strong materials are difficult to process in a milling unit, especially since onsite manufacturing processes are expected to take only a short time. Furthermore, the material should also exhibit a tooth-like appearance in accordance with a certain esthetic sensibility. Onsite fabrication methods are not conceived for elaborate enhancements, such as ceramic veneers. The term “monolithic restoration” has become established in this context. This term describes a material that meets the requirement for adequate esthetic integration straight away, without necessitating any reworking. Furthermore, the materials should offer good conditions for adhesive bonding, especially as ever more tooth-preserving preparation techniques are preferred (Table 1).

Historical review

The beginnings of CAD/CAM fab-
IPS e.max® ZirCAD
The perfect combination of strength, esthetics and translucency

- Polychromatic MT Multi discs for efficiency and highly esthetic restorations
- High flexural strength and fracture toughness for a broad indication range
- Low wall thicknesses for less invasive preparations
- Three translucency levels (MO, LT, MT) for natural esthetics
Fig. 14: The final result in 2008: beautiful optical integration.

Fig. 15: Check-up after 5 years (2013): restorations still look beautiful.

Fig. 16: The UR1 and UL1 of this 23-year-old female were damaged in an accident and restored with composite material.

Fig. 17: As the result was esthetically unsatisfactory, the teeth were prepared using a planned, minimally invasive procedure.

Fig. 18: The exceptional optical properties of IPS e.max CAD Impulse O1 enable a completely natural appearance...

Fig. 19: ...and provide a high brightness effect in direct light due to the high level of opalescence and fluorescence.

Fig. 20: The teeth were restored to the correct proportions and the smile line was optimised. The patient was satisfied with the result.

Fig. 21: The 3-year check-up did not show signs of ageing.

Fig. 22: A patient wearing 10-year-old veneered zirconia crowns wants her esthetic appearance to be improved. The crowns appear rather dark and grey. The proportions look unflattering.

Fig. 23: The variation in the shade of the preparations made it necessary to use a relatively opaque material that nonetheless provided a certain brightening effect.

Fig. 24: The new restorations were ground from IPS e.max CAD M1.

Fig. 25: The preparations were effectively concealed under the new crowns (cut-back method) and the brightness of the teeth was considerably increased.

Fig. 26: The final result shows a pleasing esthetic appearance.

Fig. 27: Preparation for a three-unit bridge with an ovate pontic design.

Table 1

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<td>- Good resistance to oral conditions</td>
<td>- High strength</td>
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<td>- Tooth-like esthetic characteristics</td>
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Basic requirements for chairside materials

- Good resistance to oral conditions
- High strength
- Easy and fast machining in the milling unit
- Tooth-like esthetic characteristics

IPS e.max CAD and its levels of translucency

Driven by the excellent optical properties, users urged the manufacturer to increase the translucency of the blocks and to enable the fabrication of monolithic restorations. Vivadent responded by introducing IPS e.max CAD LT in 2007 (Figs 10 to 11). LT stands for low Translucency. These blocks ensured that met a high esthetic standard, particularly when used in conjunction with the accompanying IPS e.max CAD Crystall./Shades and Stains characterization materials. With its user-friendly and compact design, the Programat CS 2007 furnace facilitated the applications at chairside.

On the one hand, the LT blocks were sufficiently translucent to mimic the characteristics of the natural tooth structure and, on the other, they were sufficiently opaque to mask “problematic” substrate. Even today, this material may still be called a universal ceramic. Nonetheless, it may be regarded as a step forward that another level of translucency was launched in 2009. These were the HT blocks (High Translucency) (Figs 12 to 15). If used in combination...
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with an appropriate luting material, this blocks allowed the shade of the substrate to be integrated into the overall optical effect of the restorations. This meant that partial crowns and veneers could now be created with ease directly onsite in a single visit. The trend towards ever less invasive procedures led to the introduction of still another variant of IPS e.max CAD: the Impulse materials (2011). Impulse Opal O1 and O2 are ideal for fabricating monolithic restorations with the aim to reproduce naturally sensitive areas without the need for veneering them.

**Typical workflow**
Preparation is mostly minimally invasive due to the high strength of the material. There are no differences with other types of restorations when it comes to optical impression-taking and computer-assisted design. The differences only become noticeable during processing in the milling and grinding machine. Lithium disilicate is a material that cannot withstand unlimited forces. Gentle processing is essential. The grinding process for a typical posterior crown takes on average 15 minutes if an MC XL milling unit is used (Dentsply Sirona). The precision can be increased by using the extra fine processing option. The processing time doubles with this option.

The future lies in the use of new technologies. The PrograMill One milling and grinding machine will deliver significantly better results in less time as it incorporates innovative new technology. For instance, the x-ray turn milling technology (x:XT) uses a robotic arm, rather than a milling motor, to move the workpiece. This enables a consistent milling and grinding procedure with many degrees of freedom and increased levels of accuracy. Only a minimal amount of resowering is required after the machining process. As the material is considerably easier to process when it is in its pre-crystallized blue state, corrections should be implemented directly at the grinding stage. A try-in can be performed before the crystallization process is carried out. The restorations were machined onsite (Figs 27 to 29).

Crystallization is a mandatory step in the IPS e.max CAD workflow. The restoration is secured on a special firing tray with the help of support pins and firing auxiliary paste (IPS Object Fix). Polishing is basically possible. However, it is also possible to apply a spray glaze or glazing paste. Individualized shade specifications can be created with IPS e.max CAD: Crystal, Shade/Translucency material at the same time as the glaze is applied. The crystallization process takes 15 minutes in the best case when using the spray glaze (speed crystallization), otherwise it takes 25 minutes. Developed specifically for the chairside method, the Programat FS furnaces (e.g. the new Programat C44 universal furnace) provide optimum results in the shortest possible time and are therefore a sensible recommendation (Figs 30 to 34).

Thanks to the high strength of the material, several options are available for seating the restorations. Adhesive bonding should always be the preferred method. Conventional cementation is also possible but requires a retentive preparation pattern, which is considered outdated by today’s standards.

**Conclusion**
IPS e.max CAD is the gold standard for chairside restorations. Together with the Programat furnaces designed for IPS e.max CAD and the corresponding cementation materials, a coherent system that ensures the necessary robustness in a wide range of applications has been developed. IPS e.max CAD sets benchmarks for efficient, tooth-preserving all-ceramic restorations that offer a high level of clinical reliability. The new zirconium oxide blocks (IPS e.max ZrCAD LT) complete the overarching IPS e.max system, in line with the motto IPS e.max – all ceramic, all you need.

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**Editorial note:** Literature is available on request from the editors.