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 onsite 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.

Note: Adhesive bonding achieves the best values if it is performed immediately after tooth preparation.

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 concepted 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 rework- ing. 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
The patient was satisfied with the result. The teeth were restored to the correct proportions and the smile line was optimally increased. The final result in 2008: beautiful optical integration.

Fig. 20: The teeth were restored to the correct proportions and the smile line was optimally increased.

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 O2 enable a completely natural appearance.

Table 1

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<th>Requirements for chairside materials</th>
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<td>- Good resistance to oral conditions</td>
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<td>- High strength</td>
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<td>- Easy and fast machining in the milling unit</td>
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<td>- Tooth-like esthetic characteristics</td>
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Ricated chairside restorations can be traced back to a certain feldspar glass ceramic. The first attempts of the CEREC era began with the Vita Mark I blocks. The material was further developed and for a long time, Vita Mark II was considered the ideal standard for processing restorations onsite. The material was relatively easy to grind and polish and was capable of fulfilling the esthetic requirements well. With a flexural strength of 120 MPa, its field of application was, however, limited. Adhesive cementation was indispensable to ensure a durable stability. By today’s standard, relatively high minimum thicknesses were required, resulting in a correspondingly high removal of tooth structure and, at times, unfavourable geometries in the design of the cavities. The introduction of the ProCAD blocks (1998) did not bring the decisive breakthrough, either. This material was based on leucite-reinforced glass ceramic and featured a flexural strength of 140 MPa. The blocks are still available in an optimized version as IPS Empress® CAD or as IPS Empress CAD Multi blocks (185 MPa) to this very day. Although these materials produced good to very good long-term clinical results, they always entailed a risk for failure in the form of fractures.

Introduction of IPS e.max CAD

A new category of glass-ceramic materials brought about the decisive improvement in 2005. Lithium disilicate. This material was instrumental in establishing CAD/CAM systems for chairside applications. Focall Vi- vadent launched the IPS e.max CAD material on the market. Initially, it was available in MO blocks (Medium Opacity) with a relatively high opacity. These blocks were designed for the veneering technique (Fig. 1). This meant that this material was, in the main, inappropriate for chairside applications. However, this is not where the story ends. Initial experiences showed that the material was dotted with excellent optical properties. In addition, the manufacturing technology made the material attractive for use in the dental practice even if it required a crystallization process of approx. 30 minutes. Above all, it was the flexural strength of 190 MPa, which was clearly superior to all materials used in this segment so far. Soon we began to use the IPS e.max CAD MD blocks for creating monolithic restorations, especially for crowns, even if originally this was not the intended use of the material.

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. Focall Vivadent responded by introducing IPS e.max CAD LT in 2007 (Figs 4 to 11). LT stands for Low Translucency. These blocks ensured results that met a high esthetic standard, particularly when used in conjunction with the accompanying IPS e.max CAD Crystal, 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” substrates. 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 O and O2 are ideal for fabricating monolithic restorations with the aim to reproduce dental enamel. Outstanding results can be achieved with comparatively minimal effort. As many users had difficulty in classifying the Impulse blocks appropriately in the product portfolio, some parts of the assortment were taken over into the recently created category MT (Medium Transparency, 2013). The IPS e.max CAD materials of the medium transparency category are mainly used to improve brightness values. Additionally, five different levels of translucency are available today. With this “toolkit”, monolithic restorations offering an utmost level of esthetics can be accomplished in a variety of clinical situations. The Shade Navigator App assists in selecting the correct translucency. In a few easy steps, this app provides useful recommendations on the selection of the correct blocks.

Range of indications for chairside applications

The range of indications for IPS e.max CAD evolved in tandem with the provision of the blocks. The LT variant is the first choice for crowns and indications that involve “problematic” substrates. Larger blocks enable the onsite fabrication of bridges (up to the second premolar as the terminal abutment). In this case, the processing time is longer than for single-tooth restorations. With the HT variant, inlays, onlays and partial crowns can be manufactured to a high-esthetic standard.

At IDS 2017, Ivoclar Vivadent launched the IPS e.max CAD 530 MPI initiative. Eleven years of continued quality testing have shown that IPS e.max CAD provides actually a mean biaxial flexural strength of 130 MPa. This is reflected in the consistently positive results of many scientific studies on the survival rate of IPS e.max CAD restorations (literature). In view of the consistent further development and favorable long-term clinical results, the minimum thicknesses recommended for adhesively cemented IPS e.max CAD crowns have been reduced to thinner dimensions. This means that preparing the teeth is easier and more tooth structure can be preserved. It also allowed the range of indications to be extended to include occlusal veneers, which have come to play a key part in raising the bite in the posterior region.

Thus, it has become possible to create single-component monolithic restorations, which are referred to as hybrid abutment crowns. The chairside production of such crowns is realistic and has established itself as a standard among CAD/CAM users for fabricating implant-supported single-tooth restorations in the posterior region.

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 35 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 3-axis turn milling technology (XT IX) 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 reworking is required after the machining process.

Conclusion

IPS e.max CAD is the gold standard for chairside restorations (Figs 35 to 39). Together with the Programat furnace 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 ZirCAD LT) complete the overarching IPS e.max system, in line with the motto IPS e.max – all in one ceramic, all in one.

Editorial note: Literature is available on request from the editors