Glass Ceramic Block
# Table of contents

1. Introduction ................................................................. 5  
2. Overview of Materials .................................................. 6  
3. Clinical Application of Glass Ceramic Blocks .................... 9  
4. Indications ................................................................. 11  
5. Shades ...................................................................... 11  
6. Composition ............................................................... 12  
7. Test Results ............................................................... 13  
   a) Strength of specimens ............................................. 13  
   b) Strength of real geometries .................................... 14  
   c) Cementation .......................................................... 15  
   d) Solubility/Biocompatibility .................................... 16  
   e) Machinability ......................................................... 17  
   f) Aesthetics ............................................................. 17  
8. Application Test ........................................................... 19  
9. Instructions for Use ..................................................... 21  
10. Clinical Case .............................................................. 24  
11. Questions and Answers ............................................... 27  
12. Summary ................................................................. 28  
13. Literature ............................................................... 29
1. Introduction

Paradigm™ C is a 3M ESPE grindable glass ceramic block for the preparation of inlays, onlays, veneers and crowns grinded with the Cerec® chairside CAD/CAM and inLab systems (Sirona, Bensheim). Paradigm C ceramic block is made out of a two phase leucite ceramic available in 6 different Vita™ classic shades (A1, A2, A3, A3.5, B3, Bleach) and offered in 5 different block sizes. Paradigm C block exhibits a chameleon effect once seated due to its brilliant translucency and fluorescence.

Fig. 1.1: 3M ESPE Paradigm™ C block made of glass ceramic

Fig. 1.2: 3M ESPE Paradigm™ C is available in different sizes (from left to right: V5-12; I8; I10; I12; I14)

Fig. 1.3: 3M ESPE Paradigm™ C is available in 6 different well-balanced shades (from left to right: Bleach; A1; A2; A3; A3.5; B3)
2. Overview of Materials

In the last two decades the amount of all-ceramic restorations and the variability in different ceramic materials steadily increased. The dental community became convinced on the use of ceramics, because they fulfill all the requirements of a dental restoration: aesthetics, biocompatibility and strength.

New ceramic materials with higher strength were developed and with the introduction of new technologies like CAD/CAM could be processed for the first time in the dental operatory. The former perception of fragile ceramics was overcome by new materials and it is now recognized that there are ceramic materials with enormous variation in specific characteristics.

Today three main classes of ceramic materials are distinguished in dentistry: glass ceramics, infiltrated and polycrystalline ceramics. They highly differ in their chemical composition and their 3D structure resulting in different mechanical and optical characteristics (Figure 2.1).

Glass Ceramics:

Feldspatic and leucite ceramics are used as veneering porcelains for either metal or all ceramic frameworks. The glass powder is applied to the restoration and fired in a dental oven at 700 to 900 °C. They have mainly an amorphous structure resulting in a high translucency and a very low crystalline content (< 5%).

Since the introduction of CAD/CAM technology 20 years ago, feldspatic ceramics are also industrially prepared as blocks. Later on Leucite ceramic blocks were introduced with a high content of Leucite crystals in order to improve the strength of the material. The two ceramic materials leucite and feldspatic ceramics are both considered as Aluminosilicate consisting of amorphous and crystalline parts. Nevertheless they differ in their chemical composition and crystalline structure. Leucite is a K[AlSi2O6] crystal whereas feldspars are best explained by a ternary system of Orthoclase (KAlSi3O8), Albite (NaAlSi3O8) and Anorthit (CaAl2Si2O8). In this ternäre system feldspars can have different chemical compositions resulting in different crystalline structures. Vita Mark II is a Sanidine (K[AlSi3O8]) reinforced feldspatic ceramic, whereas ProCad and Paradigm C are both leucite reinforced ceramics. Due to their special chemistry both have higher translucency compared to the other ceramics (infiltrated and polycrystalline), but also lower flexural strength (Figure 2.2). However, ceramics can be subjected to ten times more stress under pressure than when pulled or bent (see Figure 2.3). They have ten times higher compressive strength compared to flexural strength and, therefore, glass ceramics show a sufficient and clinically proven strength (see chapter 3.) for indications like inlays, onlays, veneers and crowns, where compressive stresses play a more important role and where tensile stresses are not as important compared to a bridge design.
Infiltrated ceramics:

Similar to the glass ceramic materials, infiltrated ceramics consist of amorphous and crystalline parts. However due to their different chemical composition (e.g. mixture of SiO₂, Al₂O₃ and ZrO₂) and the higher percentage of crystalline structure, they show 3 to 4 times higher strength compared to glass ceramics (Figure 2.2). They have sufficient strength for crowns in the anterior and posterior region and a sufficient strength for anterior bridges.

Polycrystalline ceramics:

With the introduction of CAD/CAM technology, high strength ceramics may be processed for the first time which made a dental application for polycrystalline ceramics possible. They have a crystalline 3D structure without amorphous parts. Especially ZrO₂ is the dental ceramic with the highest flexural strength of approximately 1000 MPa and excellent long term stability (see also Lava Crowns & Bridges, 3M ESPE, Figure 2.2). Therefore, ZrO₂ is the material of choice for bridges especially in the posterior region, and it is clinically proven for crowns and bridges in the anterior and posterior region.

Ceramic Materials for chairside CAD/CAM technology:

There are lab-based systems for dental technicians and chairside CAD/CAM systems for dentists in the market today.

Polycrystalline ceramics and infiltrated ceramics are used in lab-based systems. The core framework is milled out of the ceramic material and polycrystalline ceramics are subsequently sintered to full density. With infiltrated ceramics the framework needs to be infiltrated with glass and finally fired. The restoration frameworks are additionally veneered with the respective overlay porcelain in order to achieve optimal aesthetics of the restoration.
The advantage of a chairside CAD/CAM system is the treatment of the patient during one appointment. In one appointment the prepared tooth will be scanned, the restoration will be designed, milled and cemented in place. The benefit of one appointment can only be achieved if the milling process of the restoration is not too time consuming. Therefore, glass ceramics are the material of choice with short milling times of approximately 20 min for inlays, onlays or crowns.

Two glass ceramic materials for chairside CAD/CAM technology (Cerec®, Sirona) are in the market, the glass ceramic Vita™ Mark II (Vita Zahnfabrik) and ProCAD, (Ivoclar Vivadent) [Figures 2.1-2.3]. Additionally, in certain regions dentists may use Paradigm™ MZ100, a composite block for Cerec systems (3M ESPE). Ceramic materials are perceived to have a higher aesthetics, the composite block MZ100 shows a higher strength, a higher elasticity and lower wear (see technical product profile Paradigm MZ100, 3M ESPE).

Due to the special chemistry and the resulting mechanical parameters, the following materials are recommended for the respective indications:

### Table 2.4: Recommended materials for different CAD/CAM fabricated restorations and indications

<table>
<thead>
<tr>
<th>Paradigm™ C block (Leucitic glass ceramic)</th>
<th>Paradigm™ MZ100 block (Composite)</th>
<th>Lava™ Crowns &amp; Bridges (Zirconium oxide)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Indications</strong></td>
<td><strong>Advantages</strong></td>
<td><strong>Advantages</strong></td>
</tr>
<tr>
<td>Inlays, onlays, veneers, crowns</td>
<td>1. Excellent aesthetic material</td>
<td>1. Zirconia is a high strength ceramic</td>
</tr>
<tr>
<td></td>
<td>2. Fast milling time, ideal for chairside applications</td>
<td>(&gt; 1000 MPa)</td>
</tr>
<tr>
<td></td>
<td>1. Higher flexural strength than glass ceramics</td>
<td>2. Long span restorations</td>
</tr>
<tr>
<td></td>
<td>2. Excellent wear</td>
<td>3. Excellent aesthetics</td>
</tr>
<tr>
<td></td>
<td>3. Fast milling time, ideal for chairside applications</td>
<td></td>
</tr>
</tbody>
</table>
3. Clinical Application of Glass Ceramic Blocks

Restorations out of CAD/CAM milled glass ceramic blocks have a clinical history of about 20 years. The first patient was treated in 1985 with a Cerec® restoration by Professor Mörmann from the University of Zürich [3.1]. The first clinical study was started soon after [3.2] and since then several clinical studies showed survival rates of 100% to 89% after 1 to 18 years (see Table 3.2).

In 1997 Hickel and Dasch reported a success rate of > 90% after 3 years for the first clinical studies with CAD/CAM milled glass ceramics [3.3]. In 1999 Martin N. and Jedynakiewicz N.M. [3.4] summarized 15 clinical studies with glass ceramic CAD/CAM milled restorations and found a mean survival rate of 97.4% over 4.2 years.

Later, Hickel and Manhart published two very thorough reviews on the clinical performance of posterior restorations (2001, [3.5]) and on the clinical performance of class I and II restorations (2004, [3.6]) made from different materials (amalgam; ceramic (pressed, cast); CAD/CAM ceramic inlays, gold; see Table 3.1).

Table 3.1: Mean annual failure rates of different dental materials; Summary of clinical review of Hickel and Manhart ([58])

<table>
<thead>
<tr>
<th></th>
<th>Posterior restorations [3.5]</th>
<th>Class I and Class II [3.6]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct restorations:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amalgam</td>
<td>0-7%</td>
<td>0-7%</td>
</tr>
<tr>
<td>Indirect restorations:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ceramic (Pressed, cast)</td>
<td>0-8%</td>
<td>0-8%</td>
</tr>
<tr>
<td>Ceramic (CAD/CAM)</td>
<td>0-5%</td>
<td>0-6%</td>
</tr>
<tr>
<td>Gold</td>
<td>0-6%</td>
<td>0-6%</td>
</tr>
</tbody>
</table>

CAD/CAM milled glass ceramic inlays and onlays showed the same annual failure rates compared to gold and hence showed a similar clinical performance compared to state-of-the art dental materials.

In conclusion, glass ceramics are clinically proven for specific indications by their long clinical history.
<table>
<thead>
<tr>
<th>Study duration</th>
<th>Tested indication</th>
<th>Survival rate</th>
<th>Success rate</th>
<th>Amount of restorations/Evaluation</th>
<th>Evaluation criteria</th>
<th>Reference First Author + year</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.9 years (mean)</td>
<td></td>
<td>99%</td>
<td></td>
<td>2328 Cerec inlays were fixed in 794 patients from 1990 to 1999 with Cerec 1 and 2</td>
<td>USPHS criteria [3.9] Posselt A. and Kerschbaum T. (2003) IntJ Computerized Dentistry 6, 3, 231-246</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>inlays/onlay</td>
<td>87%</td>
<td>80% (chipping and hairline cracks in 2 cases from Celay)</td>
<td>30 inlays</td>
<td>CDA criteria [3.12] Thordrup et al. (1999) Quintessenz International 30, 12, 829-836</td>
<td></td>
</tr>
<tr>
<td>3 years</td>
<td>different restorations</td>
<td>100%</td>
<td>97%</td>
<td>58 onlays, crowns, endo-crowns, veneers, 4 crowns on implants, evaluation of marginal integrity, anatomic form, secondary caries, color match, marginal discoloration</td>
<td>USPHS criteria [3.13] Reich S. et al. (2004) JADA 135, 5, 605-612</td>
<td></td>
</tr>
<tr>
<td>4 years</td>
<td>different restorations</td>
<td>100%</td>
<td></td>
<td>50 inlays, evaluation of open margin, recurrent decay, surface texture, stain and discoloration, sensitivity and fracture</td>
<td>USPHS criteria [3.14] Estafan D. et al. (1999) Compendium of Continuing education in dentistry 20, 6 555-560</td>
<td></td>
</tr>
<tr>
<td>4.5 years (65 month +/-15 month)</td>
<td>different restorations</td>
<td>crowns classic: premolar/molar 97%/95% reduced crowns 93%/92% endo crowns 69%/87%</td>
<td>208 crowns and endo-crowns (n=86)</td>
<td></td>
<td>USPHS criteria modified [3.16] Bindl et al. A (2005) IntJ Prosthodontics 8, 3, 219-224</td>
<td></td>
</tr>
<tr>
<td>5 years</td>
<td>inlays/onlays</td>
<td>100% gold ceramic inlays 92% ceramic inlays</td>
<td>20 patients received each one cerec, one Empress, one Mirage and one gold inlay</td>
<td></td>
<td>CDA criteria [3.17] Molin et al. (2000) IntJ Prosthodontics 13, 3, 194-200</td>
<td></td>
</tr>
<tr>
<td>5 years</td>
<td>inlays/onlays</td>
<td>88% all materials 93% for Cerec (one fracture)</td>
<td>Evaluation of the clinical performance of direct and indirect inlays out of ceramic and composite no significant difference among the survival rate of the different inlays</td>
<td>CDA criteria [3.19] Thordrup M. et al. (2001) Quintessenz International 32, 3, 199-201</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10 years</td>
<td>inlays/onlays</td>
<td>90.4% (Kaplan Meier)</td>
<td>200 Cerec restorations were placed; 187 were evaluated after 10 years</td>
<td></td>
<td>USPHS criteria modified [3.22] Otto T. and De Nisco S. (2002) IntJ Prosthodontics 5, 2, 122-128</td>
<td></td>
</tr>
</tbody>
</table>

Table 3.2: Main clinical studies with chairside CAD/CAM milled restorations
4. Indications

Paradigm™ C Glass Ceramic Blocks can be used for the following indications:

- Inlays
- Onlays
- Crowns
- Veneers

5. Shades

Paradigm C Glass Ceramic Blocks are available in 6 different shades: A1, A2, A3, A3.5, B3 and Bleach and in 5 different sizes (I8, I10, I12, I14, V5-12).

*Fig. 5.1: Different shades of Paradigm™ C glass ceramic blocks: Bleach, A1, A2, A3, A3.5, B3*
6. Composition

The Paradigm™ C millable Glass Ceramic Block is derived from a molten Alumino-Silicate glass composition with Alkali Oxides like K, Na and Earth-Alkali Oxides like Ca, Ba and Ce. After grinding and compacting of the glass powder a special heat treatment process creates approximately 30% ± 5% Leucite crystals within the blocks. Therefore, the user of Paradigm C does not need any further crystallization step to achieve the final strength of Paradigm C.
7. Test Results

The clinical success of dental restorations highly depends on the mechanical and optical characteristics of the material, e.g. its strength, long-term stability, its translucency and fluorescence as well as the bond to the cement. In the following pages, the characteristics of Paradigm™ C glass ceramic blocks will be compared to glass ceramic materials currently in the market.

a. Strength of specimens

The DIN EN ISO 6872 defines the strength requirements for dental ceramics according to their intended use. For dental ceramics used for the fabrication of inlays, onlays and crowns a minimum strength of 100 MPa is required.

In Figure 7.1 the flexural strength of Paradigm C is compared to competitive glass ceramic blocks (Vita™ Mark II, ProCAD®). The graph shows two sets of data which compare the specimens tested based on ISO 6872 and specimens milled by the Cerec system. Based on ISO the ceramic specimens were polished in order to get an optimal surface before the measurement. Paradigm C block did not show any significant difference compared to Vita Mark II, whereas ProCAD showed a higher strength, than both Paradigm C and Vita Mark II blocks.

Additionally, the flexural strength of milled specimens without any further surface optimization was analyzed. Clinically, only the occlusal surface is polished. The surface, where tensile stresses normally occur is clinically still in the as-milled state of the instrument. Here, Paradigm C block showed the same strength compared to Vita Mark II and ProCAD.

![Figure 7.1: Flexural strength of Paradigm™ C glass ceramic block in comparison to competitor materials. Paradigm C glass ceramic shows the same flexural strength based on ISO compared to Vita™ Mark II. Milled specimens of Paradigm C glass ceramic have the same strength compared to Vita Mark II and ProCAD® (3M ESPE internal data)](image)

The strength of ceramics are usually reported with a Weibull statistic instead of Gaussian statistic. The advantage is that the probability of failure can be determined at a certain load. In Figure 7.2 the Weibull distribution of the three materials are shown. All distributions are similar. The failure probability < 100 MPa was 0% for Paradigm C material.
b. Strength of real geometries (crowns)

The strength of crowns with an axial wall thickness of 1.0 mm and occlusal wall thickness of 2 mm was measured for Paradigm™ C Glass Ceramic Blocks and the competitive materials. Ten crowns of each material were milled with the same design (same Cerec® project), cemented with RelyX™ Unicem Self-Adhesive Resin Cement and cyclically loaded. Subsequently, the strength was measured in an universal testing machine (Instron 5566).

Paradigm C glass ceramic shows the same strength and long-term stability compared to the competitive materials.

Fig. 7.2: Weibull plot for the different glass ceramic materials (3M ESPE internal data)

Fig. 7.3: Long term stability (3M ESPE internal data)
c. Cementation

Glass ceramic restorations must be bonded adhesively, because it has the advantage of leading to a chemical bond between the restoration and the tooth. In this way, the surface can be sealed and in consequence, the fracture strength is further increased [7.1].

Glass ceramic materials are usually etched by hydrofluoric acid, silanized by a silane agent and subsequently bonded by a resin cement. The etching step causes an increase in the surface roughness resulting in increased micromechanical retention. The silanization agent leads to chemical bond between the inorganic ceramic material and the organic resin. These compounds normally have two functional groups, one silane group and one double bond. The silane end of the molecule reacts with the hydroxy groups at the ceramic surface, whereas the double bond polymerizes with the monomers of the resin cement (see Figure 7.4).

![Silane molecules approaching the inorganic glass ceramic surface](image)

*Fig. 7.4: The silane molecules (on the right) approach the inorganic glass ceramic surface which is covered with hydroxide groups and water molecules.*

Paradigm™ C Glass Ceramic Block restorations must be cemented in conformity with general rules of adhesive technology, using an adhesive (e.g. RelyX™ ARC; RelyX™ Veneer for veneer indications) or Self-Adhesive Resin Cement (RelyX™ Unicem).

The shear bond strength of Paradigm C glass ceramic material to different adhesive and self-adhesive cements was determined by PhD Dr. J. Fischer from the University of Bern and compared to the respective shear bond strength of the cements to Vita Mark™ II (Figure 7.5 a and b). The glass ceramic material was etched with HF (< 5%), silanized (Ceramic Primer) and sub-sequently the cement was added and polymerised either by light curing or chemically curing dependent on the kind of cement used. All specimens were incubated in water for 24 hours (36 °C) prior to thermocycling (1500 cycles, 5/55 °C).

By HF etching and silanization of Paradigm C glass ceramic material a high shear bond strength can be achieved in combination with different adhesive and self-adhesive cements (Figure 7.5 a and b). Moreover, Paradigm C glass ceramic material in combination with Ceramic Primer and RelyX Unicem shows the same shear bond strength compared to a adhesive cementation (e.g. Variolink) and only slightly lower than Panavia F/2.0 by following an easier handling process (for more information on RelyX Unicem see also the Technical Product Profile RelyX Unicem).
d. Solubility/Biocompatibility

Ceramics are considered as biocompatible material because of their very low solubility. According to ISO 6872 ceramic materials must have a solubility lower than 2000 µg/cm² for materials used with frameworks and lower than 100 µg/cm² for those in contact to the surrounding humidity in the mouth of the patient. CAD/CAM milled restorations have to show a solubility lower than 100 µg/cm². Paradigm™ C Glass Ceramic Block meets the requirements of the ISO norm and shows a very low solubility (Fig. 7.6).
e. Machinability

Paradigm™ C material showed the same grinding behavior as other competitive glass ceramic materials. In Figure 7.7 the mean grinding time for 10 crowns of Vita™ Mark II and Paradigm C material are shown. For more information concerning machinability see also chapter 8. 3M ESPE Application test.

![Fig. 7.7: Mean milling time of 10 crowns of the same design out of Vita™ Mark II and Paradigm™ C Glass Ceramic Block (3M ESPE internal data)](image)

f. Aesthetics

Shade match, translucency and fluorescence are main requirements for excellent aesthetics. Paradigm C Glass Ceramic Block shows a high translucency and fluorescence over all colors (Figure 7.8 and 7.9).

![Fig. 7.8: Translucency of different CAD/CAM glass ceramic materials. Comparison of different shades (standard shades). (3M ESPE internal data)](image)
Aesthetic requirements can be optimized, but still aesthetics is something very subjective. We believe the best way to learn more about the aesthetic possibilities of Paradigm™ C Glass Ceramic Block is to put a Paradigm™ C restoration, to your own test.

Fig. 7.9: Fluorescence of Paradigm™ C Glass Ceramic Block (in each picture left) in comparison to Vita™ Mark II (in each picture right) A1(a), A2(b), A3(c), A3.5(d), B3(e); Photography under UV lamp. (3M ESPE internal data)
8. Application Test

Summary of Results:

Paradigm™ C Glass Ceramic Block was clinically evaluated within an application test by European dentists in 2005. The combination of Paradigm™ C Glass Ceramic Block with RelyX™ Unicem Self-Adhesive Resin Cement was part of this evaluation.

Altogether 146 restorations were made. Overall 83% of the dentists were satisfied or very satisfied with the Paradigm C. The best ratings were given for chameleon effect and translucency, which were judged as better compared to other available glass ceramic blocks. For other parameters, e.g. color matching, polishing, handling, grindability, marginal fit and overall aesthetics, Paradigm C Glass Ceramic Block showed the similar good performance to other glass ceramic blocks (Fig. 8.3).

According the majority of the dentists, the system Paradigm C – RelyX Unicem cement was judged to provide optimized process flow regarding time. The majority of the testers indicated the system Paradigm C – RelyX Unicem cement guarantees a simple and safe process flow.

Overall satisfaction with the Paradigm C

Overall the dentists were highly satisfied with Paradigm C Glass Ceramic Block.

Shade match of Paradigm C restorations after insertion in comparison to the pre-selected color.

The inserted restorations matched well to the preselected colors.
Handling of Paradigm™ C Glass Ceramic Block

Overall the handling of Paradigm C was judged as easy. Cutting-off the grinded work from the block was rated best, followed by the insertion of the blocks into the holder, and the removal of the blocks from the packaging.

Polishing result of Paradigm C

Dentists judged the polishing behaviour of Paradigm C restoration as very good, and slightly better compared to competitive products. Also the time required for polishing was judged as somewhat shorter compared to their current material.

Translucency and chameleon effect of the Paradigm™ C Glass Ceramic Blocks

Compared to other glass ceramic blocks, translucency and chameleon effect were rated as better.

Properties of 3M ESPE glass ceramic in comparison to other glass ceramic blocks

Fig. 8.3: Properties of 3M ESPE glass ceramic in comparison to other glass ceramic blocks

The new glass ceramic in the system

Eighty-three percent (83%) of the dentists stated that the system Paradigm C Glass Ceramic Block and RelyX™ Unicem Self-Adhesive Resin Cement guarantees a simple, safe and timely optimized process flow in the office.
9. Instructions for Use

Product Description

Paradigm™ C Glass Ceramic Block, manufactured by 3M ESPE, are grindable glass ceramic blocks for CEREC® and inLab® devices of the company Sirona, Bensheim, Germany. Paradigm C blocks are characterized by strength and outstanding esthetics. They are available in six colors (A1; A2; A3; A3.5; B 3; Bleach) and five sizes (I8, I10, I12, I14, V5-12).

Indications

- Manufacture of all-ceramic inlays, onlays, crowns, and veneers

Contraindications:

- All types of bridges, telescope crowns, and anchors
- Restorations for patients with hyperfunction (bruxism)

Cavity Preparation

- Prepare the tooth in conformity with guidelines for all-ceramic restorations prescribed in dentistry.

Fabrication of the Restoration

The clinical situation is optically scanned and then processed by the software. The restoration is fabricated in the grinding unit. Please see the Instructions for Use for information about operation of the CEREC® or inLab devices.

- Take into consideration the following parameters when modeling the restoration, cf. also CEREC® 3D preparation guidelines:
  - Inlays, onlays: 1.5 mm minimum wall thickness in the fissure
  - Veneers: 0.7 mm minimum wall thickness
  - Crowns: 2 mm occlusal and 1.5 mm circular wall strength

Shaping

Caution: ceramic dust is harmful to your health! Whenever working on ceramic, use a suction device with a fine dust filter commonly used in the dental practice, and wear protective goggles and a mask.

- Grind down the studs left by the grinding process with a fine-grain diamond grinding tool, applying slight pressure.
- As necessary, finalize the restoration with diamond grinding tools.
- Check the fit of the restoration in the cavity or, for Sirona inLab, on the model.
- Clean the restoration with a steam blaster or with a brush under running water, then dry with air free of oil and water.
- If no glaze firing is to be performed, seat the restoration adhesively, see Cementing.
Cementing

Do not use glass ionomer cements or resin-modified glass ionomer cements (RMGI) and compomeres. We recommend that you not sandblast the glass ceramic.

- Cement the Paradigm C restorations in conformity with general rules of adhesive technology, using an adhesive or self-adhesive composite cement, e. g.: RelyX™ Unicem, Aplicap™/Maxicap™, RelyX™ ARC, or RelyX™ Veneer, all manufactured by 3M ESPE. Procedure and indications: see the relevant instructions for use.

Pre-treatment of the cavity:

- The cavity must be pre-treated in different ways depending on the cement to be used; please follow the instructions for use for the cement precisely.

Pre-treatment of the restoration:

- Etch the basal surface of the restoration with a < 5% hydrofluoric etching gel for 90 seconds.
- Follow manufacturer's instructions for use when processing the hydrofluoric etching gel.
- Do not use the etching gel in the patient's mouth, and always wear protective clothing!
- Then rinse with water for 15 seconds and dry with air free of water and oil.
- Do not allow the rinse water to enter the drainage system until it has been neutralized.
- Then apply an appropriate silane in accordance with the instructions for use, e. g. RelyX™ Ceramic Primer, manufactured by 3M ESPE: allow to react for 5 sec, then blow completely dry so that the solvent evaporates completely.
- Following steps: see instructions for use of the cement.

Polishing

- Polish the cemented restoration, using the polishing brushes and pastes commonly used for ceramic.

Precautionary Measures

3M ESPE MSDSs can be obtained from www.mmm.com or contact your local subsidiary.

Storage and Stability

Store the product at 15-25°C/59-77°F. Do not use after the expiration date.

Customer Information

No person is authorized to provide any information which deviates from the information provided in this instruction sheet.

Warranty

3M ESPE warrants this product will be free from defects in material and manufacture. 3M ESPE MAKES NO OTHER WARRANTIES INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. User is responsible for determining the suitability of the product for user's application. If this product is defective within the warranty period, your exclusive remedy and 3M ESPE's sole obligation shall be repair or replacement of the 3M ESPE product.
Limitation of Liability

Except where prohibited by law, 3M ESPE will not be liable for any loss or damage arising from this product, whether direct, indirect, special, incidental or consequential, regardless of the theory asserted, including warranty, contract, negligence or strict liability.

Information valid as of April 2006.
10. Clinical case

Clinical images by Dr. Stergios Zafiriadis, Zollikerberg, Switzerland
Restoration of tooth 26 with 3M ESPE Paradigm™ C Glass Ceramic Block,

Fig. 9.1: Initial situation: Amalgam filling on tooth 26

Fig. 9.2: Color selection

Fig. 9.3: Preparation on tooth 26 after removal of amalgam filling and secondary caries
Fig. 9.4: Prepared tooth with scanning powder

Fig. 9.5: Adaptation of the approximal contact points and try-in of the inlay

Fig. 9.6: Etching of inlay with HF (<5%)

Fig. 9.7: Seating of silanized inlay
Fig. 9.8: Cementation with resin cement

Fig. 9.9: Light curing

Fig. 9.10: Removing of rubber dam adapting and polishing of the occlusion

Fig. 9.11: Final Cerec® Inlay made of 3M ESPE Paradigm™ C Glass Ceramic Block color A1
11. Questions and Answers

**How is a Paradigm™ C restoration cemented?**
Paradigm C Glass Ceramic Block restoration must be cemented in conformity with general rules of adhesive technology, using an adhesive (e.g. RelyX™ ARC; RelyX™ Veneer for veneer indications) or self-adhesive composite cement (RelyX™ Unicem) and e.g. RelyX™ Ceramic Primer.

**How can a Paradigm C restoration be polished?**
Paradigm C can be polished with common polishing brushes and polishing pastes for ceramic.

**Wall thickness**
With the allowed wall thickness from Cerec, 3D you can reach adequate stability of the restorations.

- Inlays, Onlay: 1.5 mm minimal wall thickness in fissure
- Crowns: 1.5-2 mm minimal occlusal wall thickness and 1.5 circular wall thickness
- Veneers: 0.7 mm minimal wall thickness
12. Summary

Herein, 3M ESPE expands the portfolio of materials for CAD/CAM technology. Besides lab based Lava™ System for high strength restorations, Paradigm™ C Glass Ceramic Block is a strong and highly aesthetic glass ceramic indicated for Cerec® chairside and inLab® restorations like inlays, onlays and veneers.

Paradigm C Glass Ceramic Block has an optimal strength for these indications, which are fabricated in an easy and fast procedure with the Cerec® chairside system in only one patient appointment. Due to the optimal translucency and fluorescence of the Paradigm C glass ceramic material, the restorations are characterized by an optimized chameleon effect.

Technical Data

Property

<table>
<thead>
<tr>
<th>Property</th>
<th>Value</th>
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<tbody>
<tr>
<td>Flexural Strength (ISO 6872)</td>
<td>&gt; 110 MPa</td>
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<tr>
<td>Flexural Modulus</td>
<td>24 GPa</td>
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<tr>
<td>Vickers Hardness</td>
<td>HV 596</td>
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<tr>
<td>Solubility (ISO 6872)</td>
<td>2.8 µg/cm²</td>
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<td>Number of Shades</td>
<td>6</td>
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<td>Number of different sizes</td>
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</table>
13. Literature

2.
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[3.1] **Reiss et al.** (2001)
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[3.2] **Mörmann W. and Krejci I.** (1992),
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[3.10] **Isenberg et al.** (1992)
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