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Cover photograph by Sascha Hein
Technology continues to change the way dentistry is practiced. In the past few years, an overflow of materials has crowded dental offices and laboratory shelves, making material selection even more difficult. Although independent clinical trials prior to the launch of novel materials are considered essential, the pace at which technology is released is far faster than that of research. When research findings finally validate their clinical acceptability, some materials may already be off the market or replaced by “newer” versions.

New findings from basic and clinical dental research have put a strong emphasis on self-healing materials. Scientists from the Center for Craniofacial Molecular Biology at the University of Southern California were able to genetically engineer enamel that can artificially trigger the formation of organized mineral and be used as a potential replacement material for natural enamel lost to caries or trauma. Another group of researchers from the Georgia Health Sciences University recently showed that simply by modifying existing materials or their technique of application, it is possible to remineralize a partially demineralized collagen matrix in bonded restorations. Yet, while these technologies will be available in the near future, mastering restorative techniques is still the focal point of a successful and esthetically pleasing restoration.

This volume of *Quintessence of Dental Technology* endeavors to provide the reader with superb examples of successful esthetic treatments performed under adverse circumstances. As newer techniques or materials arrive and are put to use, little may be known about their weaknesses, sometimes requiring practitioners to take considerable risks. Notwithstanding the negative implication of the word risk, it might instead be considered a great opportunity for us to leave our comfort zone and expand our boundaries. This process is not easy and involves emancipation from any unsubstantiated sense of security that nonetheless makes us feel safe. When this intellectual exercise is associated with meticulous planning, it forces us to increase our concentration and focus, ultimately optimizing our skills. If carefully designed, calculated risks often pay off.

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to simulate the shade and optical effects prior to firing (Fig 25). A single-tooth restoration can be slowly and accurately composed. After removal of the foil, the opaque zone, which was created to block out the discoloration of the abutment tooth, becomes visible (Fig 26). The restoration closely matches the appearance of the adjacent tooth (Figs 27a and 27b).

**Fig 25** The porcelain may be mixed with Prevu liquid (Synspar) to simulate the shade and optical effects prior to firing.

**Fig 26** After removal of the foil, the opaque zone designed to mask the discoloration becomes visible (3:1 mixture of opaque dentin and powder opaquer).

**Figs 27a and 27b** Using the envelope technique, the resemblance of the single-tooth restoration to the natural teeth is stunning.
Full Crowns

In some cases, platinum foil lends itself to the manufacture of adhesively luted full crowns. This is realized in the third case shown, in which the patient presented with an anterior open bite. Another indication may be restorations for mandibular anterior teeth that offer too little space for a coping, regardless of the material. The main fold is typically located lingually and is soldered with a gold bonding agent. If larger amounts of porcelain are required, it is advisable to pre-fire some bulk porcelain first to better control the overall shrinkage. With full crowns, this is best done with a mix of dentin and opaque dentin (50:50) to prevent a gray restoration (Figs 28 to 30). Next, the shape is sculpted to create the anatomical form (Fig 31). As expected, the adhesively luted crown is visually pleasing (Fig 32).

Closing a Diastema

Closing a diastema, either minimal or noninvasive, is probably the most classic indication of the platinum foil veneer. The fourth and last case illustrates an even simpler and faster method to adapt and swage the foil. Here, the foil is pressed between a silicone...
Fig 19  CLSM showing prebonded dentin after preparation and after adhesive cementation. There is minimal interaction of the second adhesive layer with the original hybrid layer. The adhesive layer interface is the area susceptible to adhesive failure. HL = hybrid layer; AL1 = first adhesive layer (after prebonding); AL2 = second adhesive layer (after cementation); ALi = adhesive layer interface; RT = resin tags.

Fig 20a  CLSM showing the effects of aluminum oxide cleaning on prebonded dentin after preparation and after adhesive cementation. Aluminum oxide air abrasion (white arrows) resulted in partial removal of the original hybrid layer (HL), followed by the formation of a new ghost-like hybrid layer (HL2). The adhesive layer interface (ALi) was also modified, allowing for the incorporation of aluminum oxide powder even after cleaning. AL1 = first adhesive layer; AL2 = second adhesive layer; RT = resin tags; W = water.

Fig 20b  CLSM showing the effects of tribochemical coating on prebonded dentin. Tribochemical coating resulted in removal of the first hybrid layer (HL) and formation of a new ghost-like hybrid layer (HL2) susceptible to dentinal fluid transudation. The first adhesive layer (AL1) was partially removed, and microgaps (white arrows) were found at the new adhesive layer (AL2). ALi = adhesive layer interface; RT = resin tags; W = water.
Figs 21a to 21d Clinical sequence of a conservative adhesive treatment of eroded maxillary posterior teeth: (a) Preoperative view; (b) wax-up; (c) ceramic onlays on the cast; (d) ceramic onlays after adhesive cementation. (Ceramist: Jose Carlos Romanini, Londrina, Brazil.)
Noritake (Noritake) is highly translucent at a thickness of 0.4 mm, allowing for its use in highly esthetic areas (Fig 14). Shade is not a concern since Katana is manufactured in nine precolored blocks (Fig 15). There is close adaptation of the core because the zirconia blocks remain stable during sintering. In addition, Katana has a flexural strength of 1,200 MPa and is suitable for full-coverage restorations in areas subjected to high occlusal forces (Table 1).

The same porcelain used to fabricate the veneer restorations (Super Porcelain EX-3) cannot be used over zirconia due to its high coefficient of thermal expansion (Table 2). Cerabien ZR (Noritake) has a coefficient of 9.1, which is similar to that of Katana (10.4). The combined use of these ceramic systems satisfies the esthetic and durability factors required for success.
The all-ceramic crown was fabricated as follows:

1. The zirconia coping was milled using the Katana computer-aided design/computer-assisted manufacture system. The thickness of the core was 0.4 mm after firing. The facial margin of the core was cut back to allow space for the porcelain margin (Figs 16a and 16b). Margin porcelain (M. Clear) was applied to the gingival marginal area (Figs 16c and 16d). This layer matched the desired cervical color of the adjacent veneer while limiting light transmission.

2. Internal stain (Cervical 1, Salmon Pink) was applied to the coping, followed by the addition of body porcelain (NW0.5B, OB White) to simulate the dimension and form of the adjacent veneer (Figs 16e to 16i).

3. Additional body porcelain (NW0.5B, OB White, Enamel 2) was added to create the mamelon structure as well as some irregular structure to mimic natural symmetry. The minimum thickness of body porcelain is 0.8 mm, which is slightly thinner than the proposed dimensions of the final restoration (Figs 16j and 16k).

4. Enamel porcelain (Enamel 2, T. Blue) was placed at the incisal third, with minimal extension into the middle third to prevent lowering the value of the final restoration (Figs 16l and 16m). This layer integrates subtle mamelon contours and the cervical extension of the translucent zone found in the halo.

5. The first layer of translucent porcelain (T1, T. Blue) was applied to cover the entire crown surface. This layer determined the degree of transparency of the final restoration. The layer was overbuilt by 10% to allow for added shrinkage, with enough space to overlay extra luster porcelain (Figs 16n and 16o).

6. The halo effect (T1, Creamy Enamel) was added to limit the degree of transparency created by the previous porcelain addition (Figs 16p and 16q).

7. The facial margin was reduced to expose 0.5 to 0.8 mm of natural tooth structure on the die cast (Fig 16r). Low-fusing translucent porcelain (M. Clear) was added, fired, and refined to produce a delicate contact-lens effect (Figs 16s and 16t).

8. The definitive veneer and crown had a distinct color contrast (Figs 16u and 16v).

---

### Table 1
**Mean Flexural Strength (MPa) of Different Ceramic Frameworks**

<table>
<thead>
<tr>
<th>Framework</th>
<th>Mean flexural strength</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katana Zirconia (Noritake)</td>
<td>1,200</td>
</tr>
<tr>
<td>Cercon Zirconia (Dentsply)</td>
<td>900–1,000</td>
</tr>
<tr>
<td>Procera Alumina (Nobel Biocare)</td>
<td>600–650</td>
</tr>
<tr>
<td>In-Ceram Zirconia (VITA)</td>
<td>550–600</td>
</tr>
<tr>
<td>In-Ceram Alumina (VITA)</td>
<td>350–450</td>
</tr>
<tr>
<td>Empress 2 (Ivoclar Vivadent)</td>
<td>250–300</td>
</tr>
<tr>
<td>Empress (Ivoclar Vivadent)</td>
<td>100–150</td>
</tr>
</tbody>
</table>

### Table 2
**Coefficient of Thermal Expansion of Different Ceramic Systems**

<table>
<thead>
<tr>
<th>Ceramic System</th>
<th>Coefficient of thermal expansion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Core ceramic</td>
<td></td>
</tr>
<tr>
<td>Procera AllZirkon (Nobel Biocare)</td>
<td>10.5</td>
</tr>
<tr>
<td>Procera AllCeram (Nobel Biocare)</td>
<td>7.0</td>
</tr>
<tr>
<td>Katana Zirconia (Noritake)</td>
<td>10.4</td>
</tr>
<tr>
<td>Cercon Zirconia (Dentsply)</td>
<td>10.5</td>
</tr>
<tr>
<td>In-Ceram Zirconia (VITA)</td>
<td>7.7</td>
</tr>
<tr>
<td>Cerec In-Ceram ZR (VITA)</td>
<td>7.6 – 7.8</td>
</tr>
<tr>
<td>Cerec In-Ceram AL (VITA)</td>
<td>7.2 – 7.6</td>
</tr>
<tr>
<td>Cerec In-Ceram SP (VITA)</td>
<td>7.5 – 7.9</td>
</tr>
<tr>
<td>Veneer Ceramic</td>
<td></td>
</tr>
<tr>
<td>Cerabien CR (CZR) (Noritake)</td>
<td>9.1</td>
</tr>
<tr>
<td>VM9 (VITA)</td>
<td>9.3</td>
</tr>
<tr>
<td>Creation ZI (Willi Geller)</td>
<td>9.5</td>
</tr>
<tr>
<td>Cerabien (Noritake)</td>
<td>6.8</td>
</tr>
<tr>
<td>VM7 (VITA)</td>
<td>7.0</td>
</tr>
<tr>
<td>EX-3 (Noritake)</td>
<td>12.4</td>
</tr>
<tr>
<td>VM13 (VITA)</td>
<td>13.5</td>
</tr>
<tr>
<td>Creation CC (Willi Geller)</td>
<td>13.5</td>
</tr>
<tr>
<td>d-SIGN (Ivoclar Vivadent)</td>
<td>12.6</td>
</tr>
</tbody>
</table>
The current focus in restorative dentistry is hard tissue preservation. This concept dictates that treatment for an indirect procedure must be as conservative as possible. In the anterior dentition, it is especially important to preserve the tooth structure regardless of the individual treatment plan.

Composite resin direct restorations are often used for minimally invasive restorations (eg, Class 3 and 4 restorations). With the development of new techniques for esthetic smile design, composite resin is also used for add-on procedures in the anterior dentition. However, there is still a lack of scientific evidence regarding the long-term clinical performance of composite resin restorations in the anterior region. When comparing composite resin and ceramic restorations, the latter has better scientific documentation in terms of esthetics, color stability, and wear resistance. This suggests that in cases of failure, the original restoration should be replaced with a ceramic veneer or crown. Before a tooth is prepared for a crown, however, a critical evaluation should be carried out to determine which conservative treatment approach to select.

Among the many conservative techniques available for anterior restorations, the use of laminate veneers has been the most investigated. The advantage of ceramic laminate veneers compared with traditional crown preparation begins with the amount of tooth structure that is preserved, allowing the restoration to

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**Concepts for an Ultraconservative Approach to Indirect Anterior Restorations**

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Along with longitudinal sections, teeth can also be sliced vertically or simply carved out.

Vertical slicing is easily achieved with a diamond disk and handpiece.

Carved tooth sections can result in impressive shots but are more difficult to make.
Once useful samples have been produced, they must be arranged for shooting. This is largely an intuitive process. However, certain guidelines derived from other artistic fields can be useful. For example, figure-ground theory states that the empty space resulting from placing figures in a given arrangement should be considered as carefully as the figures themselves (Figs 20 and 21). This concept ties in with the Law of Prägnanz, which describes the mind’s tendency to interpret ambiguous images as simple and complete, versus complex and incomplete. The vertical slices in Fig 17, for example, were arranged to take on the appearance of tree trunks. Another major source of advice on figure arrangement is the work of Kandinsky. Once a number of good images have been gathered, an object can be separated from the original background using the quick selection tool in Photoshop. This allows for infinite arrangement possibilities. The most commonly applied methods include use of graduated backgrounds, lens flare, reflections, and opacity (Figs 22 and 23).

**Image Composition**

Objects can be separated from the original background using the quick selection tool in Photoshop. This allows for infinite arrangement possibilities.