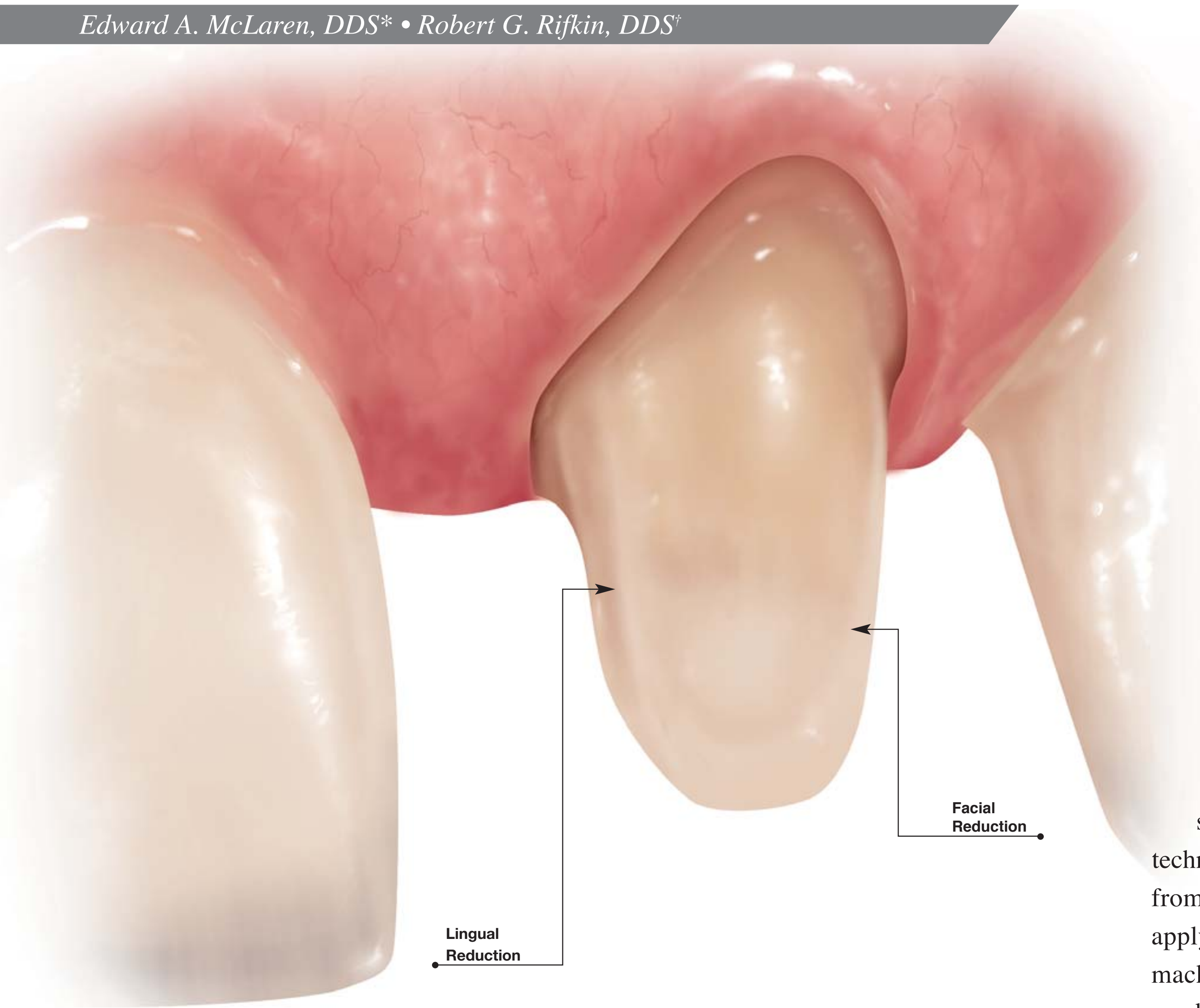
Porcelains in 2004:
Contemporary Trends and Techniques

Edward A. McLaren, DDS • Robert G. Rifkin, DDS†*



Recent advancements in dental technology, materials, and equipment have contributed significantly to the level of aesthetic dentistry being achieved today. Among these innovations, the development of all-ceramic restorations has evolved to include a variety of high-strength options. This article will review current trends in porcelain technologies including core material, veneering porcelains, adhesives, and instrumentation.

CORE TECHNOLOGY

The most significant trend for porcelain cores is the growing reliance on machining technologies and high-strength ceramic materials. Although an alumina-based product (ie, Procera, Nobel Biocare, Yorba Linda, CA) was the first solid sintered core material to challenge the traditional metal framework, core technology is increasingly dominated by zirconia products (eg, Procera Zirconia, Nobel Biocare, Yorba Linda, CA; Cerec 3D, Sirona, Charlotte, NC; Cercon, Dentsply Ceramco, York, PA; Lava, 3M ESPE, St. Paul, MN; Vita YZ, Vident, Brea, CA) (Figures 1 through 4). Zirconia's popularity stems from its strength, relative ease of cementation, and predictability resulting from automated machining. While still too new to have generated five- and 10-year studies, the author has yet to encounter a single failure in the three years of utilizing zirconia frameworks for single crowns and some short bridges at the UCLA Center for Esthetic Dentistry. Three-year data from studies in Germany and Switzerland, where zirconia-core technology was developed, are now emerging with similar results.[1] Since the coefficient of thermal expansion differs with each ceramic core system, a parallel trend in porcelain technology has been the proliferation of porcelain materials for use with the new cores (eg, Vita VM7 and VM9, Vident, Brea, CA; Cerabien and CZR, Noritake, Exclusively distributed by Darby-Spencer-Mead, Westbury, NY; Lava, 3M ESPE, St. Paul, MN; Cercon Ceram, Dentsply Ceramco, York, PA).

The emergence of the high-strength, nonmetal core has been facilitated by the development of computer-assisted design/computer-assisted machining (CAD/CAM) technology. CAD/CAM systems utilize computerized die scanning techniques to automate the milling of copings from a nonmetal monoblock material or, by applying an alumina or zirconia slurry to a machined die (Figures 5 and 6). The machined framework is then fired in a special furnace to complete sintering, after which the completed framework is readied for porcelain application (Figure 7). With either technology, CAD/CAM minimizes the human flaws inherent in handmade fabrication and increases efficiency and cost effectiveness. In addition to core applications, CAD/CAM technology makes it possible to fabricate ceramic abutments from alumina or zirconia for more natural implant aesthetics in the anterior region (Figures 8 and 9).

PREPARATION AND CEMENTATION

Preparation designs for porcelain veneers have become increasingly conservative, with demonstrated success when tooth structure is relatively strong.[2] Research indicates that longevity is not significantly affected by preparation design at the incisal edge (eg, facial window, incisal wrap, incisal shoulder), although overpreparation in the palatal

EVOLUTION OF PORCELAIN VENEERS

TECHNIQUE	**REFRACTORY/FOIL** using conventional feldspathic porcelains
HISTORY	Early 1980s
ADVANTAGES	Conservative tooth preparation
	Long-term durability
	Excellent aesthetics
DISADVANTAGES	Abrasive to opposing dentition
	Difficult to modify
TECHNIQUE	**LAYERED PRESSABLE GLASS**
HISTORY	1989
ADVANTAGES	Less abrasive to opposing dentition
	More fracture resistant
	Capable of being tried in/modified
	Good to excellent aesthetics
DISADVANTAGE	More aggressive tooth preparation
TECHNIQUE	**LEE CULP LAYERED PRESSED GLASS TECHNIQUE**
HISTORY	Mid-1990s
ADVANTAGES	More conservative preparation than conventional pressable glass
	Less abrasive to opposing dentition than conventional porcelain
	More fracture resistant than conventional porcelain
	Capable of being tried in/modified
	Good to excellent aesthetics
DISADVANTAGE	Slightly more aggressive preparation than refractory or foil veneer
TECHNIQUE	**LOWER-FUSING FINE-GRAIN PORCELAINS**
HISTORY	Late-1990s
ADVANTAGES	Familiar fabrication techniques (ie, foil, refractory)
	Conservative tooth preparation
	Less abrasive to opposing dentition than conventional porcelain
	More fracture resistant than conventional porcelain
	Excellent aesthetics
DISADVANTAGES	More fracture potential than with pressed glass
	Difficult to modify

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area may be associated with an increased probability of fracture.[3] Preparation design for restorations with zirconia- and alumina-based crowns is somewhat more complicated. While these materials are not as opaque as metal, they are also not as translucent as glass, necessitating a more aggressive preparation in order to create the space required for an aesthetic porcelain restoration. A minimum of 1.2 mm of space is required, with 1.5 mm ideally on the facial aspect (Figure 10). When available space is less than 1.2 mm, a more translucent ceramic restoration is indicated (eg, In-Ceram Spinell, Vident, Brea, CA; IPS Empress, Ivoclar Vivadent, Amherst, NY). The primary indication for high-strength ceramic cores is in the posterior zone where stress is the greatest. Hence, the author uses zirconia- and alumina-based cores in the anterior region only when they are also used to restore posterior teeth and when crowns are indicated in the anterior region.

A further preparation consideration when high-strength ceramic cores are being utilized is margin design. A porcelain margin is indicated when the margin will or may be visible, therefore, a shoulder preparation or a heavy chamfer is ideal. The use of beveled preparations is not advised with high-strength cores as it is difficult to replicate a bevel or knife-edged margin with CAD/CAM technology (Figure 10).

In porcelain cementation, the current trend is toward one-step materials that simplify adhesion. Some products (eg, Unicem,

FIGURE 1. Procera Alumina copings (Nobel Biocare, Yorba Linda, CA) were viewed on the cast with a slight facial cutback for the porcelain margin.

FIGURE 2. Final preparation for an all-ceramic crown restoration was demonstrated on tooth #9(21).

FIGURE 3. Restoration of the coping was then completed.

FIGURE 4. The final restoration provided both strength and natural aesthetics.

FIGURE 5. CAD/CAM technology enabled the automated milling of monoblock materials.

FIGURE 6. A monoblock of zirconia was machined in the laboratory utilizing the Lava system (3M ESPE, St. Paul, MN).

FIGURE 9. The Vita copings were then veneered and cemented.

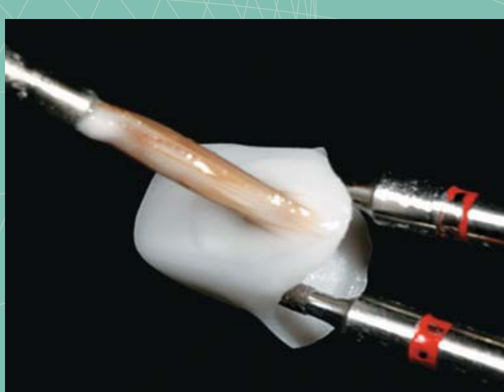

FIGURE 7. The first layer of liner porcelain was applied to the finished zirconia coping and used as a bonder.

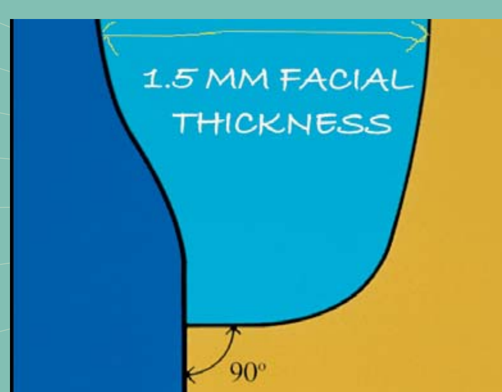

FIGURE 10. Ideal margin design and optimal facial crown thickness for excellent aesthetics with zirconia included a minimum of 1.2 mm of space, with an ideal of 1.5 mm on the facial aspect.

FIGURE 8. Zirconia abutments provided a regular platform for implants in situ.

FIGURE 11. A single crown restoration at tooth #8(11) was cemented, which provided the ideal translucency for the anterior all-ceramic restoration.

3M ESPE, St. Paul, MN) contain an acidic monomer for etching the tooth, a primer, a dental bonding agent, and a cement. In addition to making successful cementation less technique-sensitive by reducing the number of steps involved, the elimination of a separate etching step has been found in the author's practice to virtually eliminate tooth sensitivity following cementation (Figure 11). Initial bond strengths from the use of one-step materials appear to be good,[4] however, data validating the long-term integrity of the material are not yet available. Evidence has emerged demonstrating that a degradation of bond strength may occur over time.[5] All-in-one materials should be used advisedly until more research results are available, especially in cases where adhesive integrity is critical to the longevity of the restoration. The core strength of zirconia- and alumina-based crowns substantially reduces the risks associated with cementing with a material that may lose some bond strength over time. With any glass-based system (eg, conventional porcelains, pressed-glass crowns, inlays, onlays), a streamlined three-step procedure utilizing a total-etch technique followed by the use of one of the new-generation bonding agents (eg, Single Bond, 3M ESPE, St. Paul, MN; OptiBond Solo Plus, Kerr, Orange, CA; One-Step, Bisco, Schaumburg, IL) and a separate cement offers a predictable approach until the long-term reliability of one-step materials can be thoroughly demonstrated. ■

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** Director of the UCLA Center for Esthetic Dentistry and UCLA Center for Esthetic Design, Los Angeles, California.*

† Private practice, Beverly Hills, California.