Material Considerations for Using Lithium Disilicate as a Thin Veneer Option

by Robert G. Ritter, DMD
Jupiter, FL
www.ritterandramsey.com

Nelson A. Rego, CDT
AACD Accredited Member (AAACD)
Santa Fe Springs, CA
www.regosmiles.com

Introduction

At a time when dentists and patients alike are seeking both esthetic and conservative smile makeover options, lithium disilicate glass ceramic is a unique material. With high strength, natural optical properties, and the ability to be pressed thin, lithium disilicate has the potential to provide new options for minimal-preparation veneers.

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Skilled and experienced ceramists now can press lithium disilicate laminate veneer restorations as thin as .3 mm with great success. When a knowledgeable and trained ceramist fabricates the restorations, natural and durable results can be achieved.[1]

Unfortunately, when pressable ceramics were introduced, there was concern about their benefits compared to feldspathic porcelain, particularly considering the amount of tooth reduction that often was necessary in order to achieve esthetic results. The minimal thickness for pressable ceramic restorations has been cited in the literature as .6 mm to .8 mm, which sometimes led to aggressive tooth reduction in the past.[2]

A pressable material composed of a promising lithium disilicate glass ceramic (IPS e.max Press, Ivoclar Vivadent; Amherst, NY) can be used in conjunction with minimal preparation techniques and smile design principles to achieve beautiful, natural-looking and long-lasting results. This article introduces readers to the material characteristics of lithium disilicate, describes its application for thin pressable veneers,

Figure 1: Preoperative close-up view of the patient showing short teeth.

Figure 2: Preoperative close-up view of the patient with her natural smile. Note the vertical maxillary excess.

Figure 3: Preoperative retracted view of the patient, emphasizing her gingival display.

Figure 4: Close-up 1:1 view of the patient's anterior teeth showing length-to-width ratio.

and outlines the clinical protocol for treatment planning and placing lithium disilicate veneers.

Understanding Lithium Disilicate

Lithium disilicate is an esthetic, high-strength material that can be conventionally cemented or adhesively bonded.[3] It also can offer a full-contour restoration fabricated from one high-strength ceramic, as well as be used in all areas of the mouth when specific criteria are met. Laboratory ceramists find that the versatility and performance of lithium disilicate enable the optimization of their productivity when fabricating restorations using this material, since either lost-wax pressing or computer-aided design/computer-aided manufacturing (CAD/CAM) milling fabrication techniques can be used.

Lithium disilicate is among the best known glass ceramics. Glass ceramics are categorized based on their chemical composition or application.[4] IPS e.max lithium disilicate is composed of quartz, lithium dioxide, phosphor oxide, alumina, potassium oxide, and other components. This composition produces a highly thermal, shock-resistant glass ceramic as a result of the low thermal expansion that occurs when it is processed. This type of resistant glass ceramic can be processed with either lost-wax hot pressing techniques or modern CAD/CAD milling procedures.

The pressable form of lithium disilicate (IPS e.max Press) is produced using a unique bulk casting production process to create the ingots. This involves a continuous manufacturing process based on glass technology (melting, cooling,

Figure 5: Dr. Stephen Chu's proportion gauge (Hu-Friedy; Chicago, IL) was used to determine the ideal measurements for the patient's crown lengthening.

Figure 6: Postoperative view of the patient at 12 weeks following the gingival crown-lengthening procedure.

simultaneous nucleation of two different crystals, and growth of crystals) that is constantly optimized to prevent defects (e.g., pores, pigments). The microstructure of the pressable lithium disilicate material consists of approximately 70% needle-like lithium disilicate crystals that are embedded in a glassy matrix. These crystals measure approximately 3 um to 6 um in length.

Polyvalent ions that are dissolved in the glass are utilized to provide the desired color to the lithium disilicate material. These color-releasing ions are homogenously distributed in the single-phase material, thereby eliminating color pigment imperfections in the microstructure.

Clinical Properties of Lithium Disilicate

For single-unit indirect restorations, lithium disilicate is, in the authors' opinion, the best restorative material available. Lithium disilicate material has been in clinical trials for the last four years with adhesive and self-adhesive/conventional cementation. The results have been positive.[5] Mechanical testing of strength using static load with a universal testing machine, subcritical eccentric loading using a chewing simulator (Willytec; Munich, Germany), and long-time cyclic loading with a chewing simulator (eGo; Regensburg, Germany) have proven several factors contributing to the material's success. First, it has been demonstrated that it is important to consider the minimum thickness of the lithium disilicate frame. Second, the internal aspects of crowns should not be sandblasted. Finally, in comparison to various restorative dental materials for crowns (e.g., leucite glass ceramic, metal ceramic, zirconia), the lithium disilicate material demonstrates superior results.

The strength of the ceramic material in contact with opposing teeth, to fulfill masticatory functions, is about 100 MPa for metal, about 100 MPa for veneered zirconia, and about 150 MPa for leucite glass ceramic. However, for the pressed lithium disilicate, the strength is in the range of 360 MPa to 400 MPa in its final anatomical shaped crown form. This "monolithic," throughout-the-restoration strength is unlike anything found in other metal-free restorative materials.[5]

Pressable lithium disilicate is ideal for inlays, onlays, thin veneers, veneers, partial crowns, anterior and posterior crowns, three-unit anterior bridges, three-unit premolar bridges, telescope primary crowns, and implant superstructures.[6-8] When minimal tooth preparation is desired (e.g., thin veneers), IPS e.max lithium disilicate allows ceramists to press restorations as thin as 0.3 mm while still ensuring strength of 400 MPa. If sufficient space is available (e.g., retrusion of a tooth), no preparation is required.

Case Presentation

A 30-year-old woman presented with short clinical crowns (Figs 1-4). Thorough clinical and periodontal examinations were performed and radiographs were taken, and an esthetic analysis of the patient's smile was conducted. It was determined that the patient required clinical crown lengthening (also sometimes called a "smile lift"), prior to undergoing any indirect restorative treatment.

The patient underwent a crown-lengthening procedure to help bring her gingival and tooth proportions into ideal symmetry (Fig 5). She was allowed to heal for six months prior to the initiation of any restorative

Figure 7: Facial retracted view of the preparations. Note that a .2-mm uniform reduction was achieved entirely in enamel.

Figure 8: View of the reduction matrix in place to verify that the required volume of minimal reduction had been achieved.

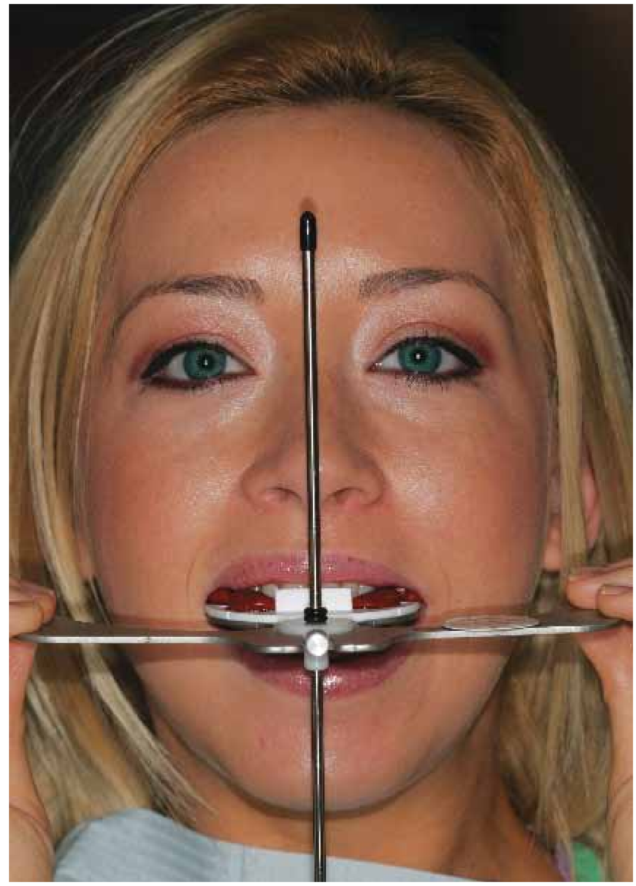

Figure 9: Dr. John Kois' dental facial analyzer (Panadent; Colton, CA) was used.

work (Fig 6). Then, a treatment plan was developed, and the case was waxed to ideal, with lengthening of the central incisors by 1 mm. The patient agreed to the placement of 10 maxillary pressed glass ceramic (IPS e.max Press) veneers. This pressable material requires significantly less tooth preparation than other indirect materials. This was important, since the patient exhibited healthy tooth structure and was caries-free. Therefore, a minimalist or no-preparation approach was used.

In particular, the authors have found that this lithium disilicate material enables clinicians to work with greater confidence when placing these types of restorations. Most of the previous thin press or feldspathic no-preparation cases demonstrated a large breakage factor. Today's lithium disilicate material, however, demonstrates a lesser chance of breaking during insertion.

Clinical Protocol

The fluoridated enamel was roughened, and a very fine finish line was established to give the ceramist a guide for where to wax. Essentially, although the case involved the placement of thin veneers, an additive wax technique was used, as no volume of enamel was removed. Preparation guides from the wax-up were used to verify the facial, lingual, and incisal reduction, as well as to ensure uniformity in the thickness of the porcelain (Figs 7 & 8).[9] A combination of depth-cutting burrs and preparation guide helped ensure that a minimalist preparation and predictable results were achieved.[10,11]

A facebow transfer, centric relation bite registration, dental facial analyzer (Fig 9), and several photographs were obtained. This informa-

Figure 10: Bisacryl provisionals (Luxatemp, Zenith/DMG; Englewood, NJ) were provided to the patient in the bleach shade.

Figure 11: The IPS e.max Press thin veneers were waxed up at the laboratory. Note their minimal thickness, which still offers great support for the ceramic. This provides the dentist with a strong shell that will seat easily, without breakage.

Figure 12: Ceram veneering ceramic was applied to the lithium disilicate substructure.

Figure 13: Close-up view of the internal, natural-looking effects after baking.

tion was forwarded to the laboratory for use in developing the case in the most predictable manner possible.[12] A shade of the prepared teeth and an occlusal bite registration were also obtained. Provisionalization was accomplished to provide the patient and the ceramist with a preview (i.e., mock-up) of where the final ceramic would be, as well as the shapes, length, and color of the anticipated restorations (Fig 10).

Laboratory Fabrication

After the patient approved the provisional "mock-up" of the final restorations, a lost-wax pressing technique was used to create the thin lithium disilicate veneers. The laboratory ceramist poured a model from the impressions that were received from the dentist, and a full-contour wax-up of the veneers was made, similar to what would be performed for any pressed restoration (Fig 11). The wax-up was sprued onto the ringer former, invested, and burned out. The IPS e.max Press ingots were then pressed into the ring replicating the wax patterns, after which the pressed veneers were divested, layered, and characterized with natural-looking stains and effects (Figs 12-14).

Cementation

The provisional restorations were carefully removed. The preparations then were cleaned with a chlorhexidine rinse (Consepsis, Ultradent Products, Inc.; South Jordan, UT) and dried. To ensure complete seating, as well as to evaluate fit, marginal integrity, color, and esthetic integration, the restorations were tried in using Variolink veneer transparent try-in gel (Ivoclar Vivadent). After approval from the patient, the veneers were removed and set aside. A total etch 37% phosphoric acid was applied to the preparations

Figure 14: Close-up view of the definitive veneers when placed on the model.

Figure 15: The veneers were cemented into place with resin cement.

Figure 16: Retracted postoperative view of the definitive thin veneers.

Figure 17: Postoperative; left lateral view revealing the reduction in gingival display and proper tooth outline.

for 10 seconds per tooth, and then thoroughly rinsed from the preparations. After etching, a desensitizing agent (Systemp Desensitizer, Ivoclar Vivadent) was applied to the preparations and lightly air-dried.

A thin layer of a single-component bonding agent (Excite, Ivoclar Vivadent) was brushed for 15 seconds per tooth onto the preparations, and then lightly air-dried. The single-component bonding agent was then light-cured for 10 seconds per tooth.

Variolink veneer resin cement was placed in the internal surface of the restorations, after which they were seated into place (Fig 15). Before curing, Liquid Strip (Ivoclar Vivadent) was applied to the veneer margins to reduce the oxygen inhibition layer. To spot-tack the restorations at the gingival third, a 2-mm light-curing tip was used, and the curing light was then waved for five seconds per tooth from the buccal aspect to initiate a gel-like consistency of the Variolink veneer cement and tack the restorations into place.

Each restoration was cured for 30 seconds from the buccal, lingual, and incisal aspects. Using OptraFine diamond polishing paste and bristle brush (Ivoclar Vivadent), the margins of the restorations were polished. After polishing with OptraFine diamond polishing paste and bristle brush, the excess cement was removed from the margins and interproximally (Fig 16).

Conclusion

This case differs from other thin or no-preparation veneer cases chiefly in terms of material selection. Clinicians and ceramists alike know that esthetic pressable ceramics are capable of being pressed to as

Figure 18: Postoperative; final full-facial view of the patient's smile.

thin as .5 mm, but with hard work. Most clinicians and laboratory ceramists would recommend the use of feldspathic porcelain as the material of choice for thin or no-preparation veneers. However, this material has its own drawback of not being able to be fabricated on the articulator because it requires the use of the platinum foil technique.

The minimal thickness for pressable ceramic restorations has been cited in the literature as .6 mm to .8 mm, which sometimes led to aggressive tooth reduction in the past.

With the true wax and pressed technique of lithium disilicate, fabrication on a fully adjustable articulator is possible, so cases can be worked out in terms of all function and excursive movements. This is among the greatest assets of this material. The literature also suggests that the fit of pressed materials can be as good as gold, approaching 25 µ in the hands of skilled technicians. The adhesive technique for placing the final restorations is exactly the same as it is for pressed or feldspathic restorations, and the esthetic results are outstanding (Figs 17 & 18).

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