Retrospective Analysis of Lithium Disilicate Laminate Veneers Applied by Experienced Dentists: 10-Year Results

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Purpose: To report on the 10-year clinical treatment outcomes for a strictly applied clinical protocol for pressable lithium disilicate glass-ceramic laminate veneers (LDLVs) placed by two experienced dentists.  
Materials and Methods: A 10-year follow-up assessment of 364 LDLVs placed in 41 patients was undertaken with the clinical criteria color/esthetic match of the porcelain surface, chipping and fracture occurrence, marginal discoloration, and integrity, assessed using the modified United States Public Health Service scoring system.  
Results: After 10 years, the survival rate was 97.4%. Complications occurred in 1.64% of the restorations (fractures and debonding in 0.55% and 1.09%, respectively).  

Currently, porcelain laminate veneer restorations are mainly fabricated out of glass-ceramic materials. Similar veneer restorations made out of pressable lithium disilicate glass-ceramic porcelain are also routinely used; however, the efficacy and effectiveness of their clinical outcomes over 10 or more years are rarely reported. Clinical studies of porcelain laminate veneers report survival rates of 90% and above over 4- to 10-year follow-up periods. Since it may be surmised that successful outcomes with porcelain laminate veneer restorations are related to clinician experience, this report on clinical outcomes of pressable lithium disilicate glass-ceramic laminate veneer restorations (LDLVs) placed by two prosthodontists using the same ceramic material, luting agent, and preparation method offers guidance to dentists on the selection of a veneering protocol.

MATERIALS AND METHODS

In this controlled clinical study, 41 patients (27 women and 14 men) aged between 20 and 60 years (mean age 29.8 years) referred between 2006 and 2007 to the Prosthodontics Department of Marmara University, Faculty of Dentistry, Istanbul, Turkey, were included. A total of 364 LDLVs were placed in the patients with complaints of mild to moderate dental wear and discoloration. The requirements of the Helsinki Declaration were observed, and the patients gave their signed informed consent. The study was approved by the Ethics Committee of the University of Marmara (No: 25/2016).
restorations were fabricated with a heat-pressing technique. Provisional restorations were made with a self-curing composite material (Structur, VOCO). All impressions were made with the single-step wash and double-sided abrasive strips (Microdont) were used to relieve the contacts with the proximal teeth. Polyvinyl siloxane impressions (Virtual, Putty and Light Body, Ivoclar Vivadent) were made with the single-step wash according to occlusal contacts was checked and arranged from the study (Table 1).

### Table 1  Inclusion and Exclusion Criteria

<table>
<thead>
<tr>
<th>Inclusion criteria</th>
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<tr>
<td>At least 18 years old</td>
<td>All patients</td>
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<tr>
<td>Able to read and sign the informed consent document</td>
<td>Severe gingival inflammation</td>
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<td>Physically and psychologically able to tolerate applied restorative procedures</td>
<td>Poor oral hygiene</td>
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<tr>
<td>Willing to return for follow-up examinations</td>
<td>High caries rates</td>
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<tr>
<td>No active periodontal or pulpal diseases</td>
<td>An existing large restoration</td>
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<tr>
<td>No systemic disorders</td>
<td>Root canal–treated teeth with less tooth structure</td>
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<td></td>
<td>Excessive interdental spacing</td>
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<td></td>
<td>More than 50% enamel loss</td>
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All patients were treated by two experienced prosthodontists (Y.O. and Y.U.A.) using identical clinical protocols at the beginning of treatment. All patients were given the same dental hygiene protocol, and all teeth planned for restorations had to be free of active periodontal inflammation, with probing depths of < 3 mm and no bleeding on probing. All patients needed to be at least 18 years old and willing to return for follow-up. Patients with severe parafunctional habits were excluded from the study (Table 1).

Veneer preparations were carried out cautiously over the diagnostic mock-up using self-curing composite material (Structur, VOCO) to minimize unnecessary enamel loss and to avoid dentin exposure. Preparations were performed after patient consent to mock-up restorations. A diamond bur kit including a 0.3- to 0.5-mm depth cutter and round-end tapered burs (Komet) was used to produce consistent veneer preparations. The cervical finish line was placed at the gingival or subgingival (0.5 mm) level in cases of intense discoloration and was designed as a chamfer finish line. The incisal finish line was designed as a butt-joint with a minimum reduction of 1.5 mm to maximize the esthetics and stability of the restorations. The finishing line of the incisal edge according to occlusal contacts was checked and arranged before preparation. All sharp edges were eliminated, and double-sided abrasive strips (Microdent) were used to relieve the contacts with the proximal teeth. Polyvinyl siloxane impressions (Virtual, Putty and Light Body, Ivoclar Vivadent) were made with the single-step wash technique. Provisional restorations were made with a self-curing composite material (Structur, VOCO). All restorations were fabricated with a heat-pressing technique using lithium disilicate glass-ceramic IPS e.max (Ivoclar Vivadent) and characterized by the cutback and layering techniques. Try-in pastes (Variolink Veneer Try-in Paste, Ivoclar Vivadent) were used to evaluate the shade of the resins, and all restorations were adhesively cemented (Variolink Veneer, Ivoclar Vivadent) by one experienced clinician (Y.O.) as follows:

After the temporary restorations were removed, all of the preparations were cleaned with a polishing brush and an oil- and fluoride-free cleaning paste (Proxyt, Ivoclar Vivadent). The preparations were then rinsed with water spray and dried with air. Try-in pastes were used to evaluate the shade of the resins. After the try-in, the paste was thoroughly washed off with water spray, and the restorations were dried with oil- and moisture-free air.

For the restorations, etching was performed with 5% hydrofluoric acid (IPS Ceramic Etching Gel, Ivoclar Vivadent) for 20 seconds, and the preparations were then rinsed thoroughly with water and dried with oil-free air. Subsequently, Monobond Plus (Ivoclar Vivadent) was applied onto the pretreated surface, allowed to react for 60 seconds, and then thoroughly dispersed with air.

For etching of the preparations, 37% phosphoric acid gel was used. The phosphoric acid was allowed to react on the enamel for 15 to 30 seconds and on the dentin for 10 to 15 seconds, then the gel was thoroughly rinsed off with a vigorous water spray for at least 5 seconds. Syntac primer (Ivoclar Vivadent) was applied to the preparation using a brush, gently rubbed in, and allowed to react for at least 15 seconds. Excess of Syntac primer was dispersed and thoroughly dried, but not rinsed off. Then, Syntac adhesive (Ivoclar Vivadent) was applied on the preparation with a brush and allowed to react for 10 seconds. Subsequently, the preparation was thoroughly dried with an air syringe. Then, Heliobond (Ivoclar Vivadent) was applied and dispersed to a thin layer. Heliobond was only polymerized together with the cementation material.

Variolink Veneer was applied directly to the inner side of the preparation. Subsequently, the restoration was seated and held in place, maintaining steady pressure. Excess cement was removed with hand instruments and a brush. Before the final curing, the restorations were cervically pre-cured for 3 seconds (tack cure) to remove excess resin from the cervical and interproximal areas using hand instruments and dental floss without pressure. In order to prevent oxygen inhibition, the restoration margins were covered with glycerine gel/air block (eg, Liquid Strip) immediately after removal of excess materials. Final curing was performed according to the manufacturer’s instructions for 40 seconds on each surface with a light-emitting diode polymerizing unit (Bluephase LED, Ivoclar Vivadent, 1,200 mW/cm²). Subsequently, Liquid Strip was rinsed off. Restoration margins were finished and further polished with extra-fine diamond finishing burs and polishing discs, and the
occlusion was checked for protrusive and lateral movements of the mandible. After placement of the restorations, oral hygiene training was performed with all patients, and a soft acrylic mouthguard was used for all patients to prevent any parafunctional activity for 1 month. The patients were seen for regular check-ups at least once per year (Fig 1).

Plaque index, gingival bleeding index, tooth hypersensitivity, changes in pulp vitality, secondary caries, esthetic match, porcelain surface, marginal discoloration, and integrity were evaluated following United States Public Health Service (USPHS) criteria. Restoration failures and reasons for failure were also recorded.

Survival and success time analyses were performed with a statistical software program (SPSS 21.0) using Kaplan-Meier and log-rank test to enhance the cumulative survival rates relative to observations. Because the majority of the patients had more than a single-laminate veneer, robust standard errors were computed. Only univariate models are presented because of the small number of events in this study.4

RESULTS

During the clinical examination recorded between December 2016 and August 2017, the following features were noted: 85.5% of the restorations were bacterial plaque–free; no significant color changes of the restoration surfaces were observed during the entire recall period; no tooth fracture was observed; and debonding and veneer fracture were observed as mechanical failures.

A total of 6 (1.64%) mechanical failures were observed in the form of debonding (1.09%) and fracture (0.55%). Four restorations were debonded; one 6 months after cementation (Fig 2), and the other three at 2 and 5 years after cementation. Adhesive failure was observed between the tooth and the luting cement in debonded restorations, and all debonded restorations were luted again. Two restorations fractured (Fig 3). Altogether, in this period 364 LDLVs were examined clinically. The 10-year survival and success analyses of the 364 LDLVs were recorded as 97.4% and 76.3%, respectively (Kaplan-Meier analysis).

DISCUSSION

This clinical study analyzed 10-year treatment outcomes for prescribed LDLVs fabricated using the same material, luting agent, and teeth preparation protocols and placed by the same two experienced clinicians. This study was undertaken because there are few studies in the literature reporting medium- to long-term survival rates of LDLVs.1,3–5 Similar long-term studies on long-term survival and complication rates for both feldspathic and glass-ceramic laminate veneers report 93.5% to 94.4%, 85.74%, and 82.83% for durations of 10, 15, and 20 years, respectively.4,5 Consequently, the outcomes of this report suggest comparably high survival rates and confirm the importance of placement by experienced dentists, as survival rates for LDLVs were 65.52% when placed by inexperienced clinicians.

Furthermore, the survival rate for porcelain laminate veneer restorations placed in patients with parafunctional habits was reported as 84.7%,4,5 suggesting that the better outcomes in the present report may be due to a more optimal patient selection. Mechanical failures of the restorations in the entire observational period were approximately 1.64% (1.09% fracture and
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CONCLUSIONS

In the present study, the clinical performance of LDLVs was evaluated after 10 years. In terms of minimally invasive treatment options, pressable lithium disilicate glass-ceramic systems are a valid, reliable, and conservative restoration in the esthetic zone. If the indications are observed, LDLVs are an excellent choice for long-term esthetic and functional success.

ACKNOWLEDGMENTS

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REFERENCES