

RESEARCH ARTICLE

Clinical performance of pressable glass-ceramic veneers after 5, 10, 15, and 20 years: A retrospective case series study

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Abstract

Objectives: To evaluate the long-term clinical performance and survival rate of pressable lithium-disilicate glass-ceramic veneers (LDSVs).

Materials and Methods: A total of 413 LDSVs were bonded to anterior and posterior teeth by three experienced clinicians between 1998 and 2012. The LDSVs were examined for color/ esthetic match of the glass-ceramic surface (esthetic evaluation), fracture rate, marginal discoloration (staining of the luting cement), and marginal integrity (including caries, clinical evaluation). For clinical and esthetic evaluations, the modified United States Public Health Services (USPHS) score was used in this study. The success rate was determined with a Kaplan-Meier survival analysis.

Results: The mean observation time was 11.33 ± 4.85 years. There was no loss to follow-up, all restorations were accounted for in the final analysis. The probability of survival of the 413 veneers was 98% after 5 years, 95% at 10 years, 91% at 15, and 87% at 20 years, indicating a very low clinical failure rate. Of the 413 restorations, complications were occurred in 15 (3.63%) of all restorations, and fractures and debonding in 6 (1.45%) and 9 (2.18%), respectively.

Conclusions: The LDSVs showed high survival rate and very good results for color match and anatomic form and marginal integrity in the long-term analysis.

Clinical Significance: The long-term performance of LDSVs can be considered as highly favorable when carefully planned.

KEYWORDS

clinical long-term study, esthetic restorations, glass-ceramics, lithium disilicate, veneers

1 | INTRODUCTION

The development of new restorative materials and adhesion techniques allowed minimally invasive dentistry to become a field of great interest due to the biocompatibility and strength of the materials used, the esthetic outcomes and color stability achieved, and the minimal preparation required. Porcelain veneer is a popular treatment

choice for rehabilitating the lost esthetic properties of malpositioned, discolored, traumatized, fractured, or worn anterior teeth.¹⁻¹⁵ To improve the esthetics of the anterior teeth, currently two types of materials are used to fabricate ceramic veneers to achieve the appropriate translucency and small required thickness: sintered feldspathic porcelain and pressable glass ceramic, which can also be milled using a computer-aided manufacturing technique.¹⁶ Glass-ceramics have superior mechanical and physical properties and may be ideally suited for use as dental restorative materials¹⁵ and are commercially available (fluorapatite, leucite or lithium disilicate [LDS]) in the form of ingots powder, or blocks.¹⁵⁻²⁰ LDS is a popular glass ceramic that was

In this controlled clinical study performed between March 1998 and June 2012, 413 LDSVs were placed at the Department of Prosthetic Dentistry, Marmara University Faculty of Dentistry and one private office. The study was approved by the ethics committee of the University of Marmara (No: 25/2016).

initially introduced as IPS Empress II (Ivoclar Vivadent) and was then succeeded by IPS e.max Press (Ivoclar Vivadent) in 2004. IPS e.max LDS can be fabricated with a heat press or CAD CAM milling technique.²¹ Bonding mechanisms and materials have improved over the years, and in modern dentistry thus bonding failures have been minimized. Selecting a luting cement is very important as it plays a significant role in the longevity and esthetics of the ceramic.^{16,19,22,30}

The preservation of enamel is vital for the long-term success of ceramic veneers, which require an optimal bond between the veneer and tooth structure. It is therefore ideal for preparations to remain within the enamel structure.¹⁸⁻²⁵

For ceramic veneers to achieve the desired esthetic and optimum function, careful treatment planning and proper tooth preparation design are essential.²⁶⁻²⁹ It is also crucial for the dentist to understand that the preparation design has a substantial influence on the survival rate and the success of the therapy.^{12,18,29}

Medium- and long-term clinical studies are very important for assessing the reliability of ceramic veneers and to support the success of this minimally invasive system.^{3-8,11,13,20,30-34} Additionally, when systematic reviews are based on clinical follow-up studies, it is possible to verify trends or associate them with an event, material, or procedure that may be a factor in ceramic veneer failures.^{13,16,19,30,31,35}

Clinical studies are fundamental because they reveal the true intraoral conditions of affected individuals. To achieve clinical success, it is essential to identify the correct indications and planning methods and the correct clinical and laboratory steps.^{1-8,10-13,17,18,20-22,30-34} To the best of our knowledge, there are no long-term studies of pressable lithium disilicate veneers (LDSVs) found in the literature that used the same material, same luting agents and the same technician along with the same experienced team treatment modality for consistent reports.

Hence, this controlled study was conducted, using the same material, the same luting agents, and the same preparation methods to obtain favorable results indicating the long-term success, survival, and longevity of LDS glass ceramic veneers. The primary aim of the present study was to determine the clinical performance of LDSVs as assessed by two experienced prosthodontists after 5, 10, 15, and 20 years.

2 | MATERIALS AND METHODS

In this controlled clinical study performed between March 1998 and June 2012, 413 LDSVs were placed at the Department of Prosthetic Dentistry, XXXX University Faculty of Dentistry and one private office. All patients were treated by two experienced prosthodontists who followed the same methodology when placing the veneers in all of the patients, and one experienced independent prosthodontist (Y.U.A.) evaluated and recorded the results according to clinical follow-up.

All LDSVs were fabricated with a heat-pressing technique using lithium disilicate glass ceramic, including IPS Empress II (until 2006) and IPS e.max (after 2006) (Ivoclar Vivadent AG, Schaan Liechtenstein). Adhesive bonding was carried out using the resin composite cement Variolink: Variolink II (only the base paste, which is light-cured) and Variolink

Veneer (Ivoclar Vivadent AG, Schaan, Liechtenstein) according to the manufacturer's recommendations.

Patients with uncontrolled parafunction, periodontitis, severe gingival inflammation, poor oral hygiene, high rates of tooth caries, large composite restorations, and less than 50% enamel were excluded from this study. No restoration was placed on an endodontically treated tooth.

At the beginning of treatment, all patients were given a dental hygiene protocol at the clinic, and all LDSVs planned teeth were required to be free of active periodontal inflammation, to have a probing depth of less than 3 mm and to exhibit no bleeding on probing. 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).

The study protocol required the following design preparation: a diamond bur kit for ceramic veneers (Ceramic Laminate Veneers Kit. Ref. 9933K3 000, LOT. 797593, Komet). The first step included the creation of orientation grooves for the vestibular reduction. Every groove was marked with a graphite pencil. A tapered shape bur was used to complete vestibular reduction until every marked groove was removed to 0.3 to 0.5 mm of the thickness of the vestibular surface of the tooth to be treated. The operator was prudent to avoid removing the entire thickness of the enamel. Only 15 teeth (two cases) required more aggressive preparation, which included enamel reduction up to 1 mm, because those teeth presented malposition. An average of 1 to 1.5-mm grooves for the incisal reduction was performed, followed by proximal preparation with a tapered diamond bur. Finally, a diamond disc was required to eliminate the contact point between teeth if there was a misalignment problem. The finished line was a curved bevel that was usually placed just at the gingival or subgingival (0.5 mm) level in cases of intense discoloration.

The impression was performed in two steps using heavy and light addition type silicone to obtain an accurate copy of the entire tooth and gingival contour. The gingival retraction was used because most preparations were slightly subgingival. In each case, temporary restorations were placed on all teeth to maintain a desirable esthetic, to avoid sensitivity to temperature changes and to prevent exposure to bacterial infection.

Temporary restorations (Structur, VOCO GmbH, Germany) were fabricated using a chairside self-curing composite and spot-bonded to the prepared tooth surface.

In this study study all pressed LDSVs fabricated using cut-back technique for further characterization using powdered-ceramic application according to manufacturer's instructions.

All LDSVs were adhesively bonded using a resin composite cement according to the manufacturer's recommendations. The tooth surface was mechanically cleaned with pumice and hand instruments. A 37% solution of orthophosphoric acid was used to treat the surface of the tooth, and a dental adhesive (Syntac, Ivoclar Vivadent) was applied. The intaglio surface of the restorations was etched with hydrofluoric acid (IPS Empress ceramic etching gel, Ivoclar Vivadent) for 60 seconds the IPS Empress II and 20 seconds for the IPS e-max, and a silane-coupling agent was then applied for 60 seconds

(Monobond S, Ivoclar Vivadent). Ceramic etching protocol with hydrofluoric acid was modified by the manufacturer over the years following material changes. While ceramic etching protocol was 60 seconds hydrofluoric acid (5%) application for IPS Empress II, it was 20 seconds for IPS e.max. This is due to the change in the glass matrix of the lithium disilicate ceramic materials. The quality of the bond is dependent on the effectiveness of how the glass-ceramic is etched, so understanding the manufacturer's recommendations is critical.

The excess cement was removed with a brush, and the LDSVs were light-cured for 3 seconds called as "Tac-Cure." Resin cement residues were removed with manual tools, and the veneer was once more light-cured at the facial and lingual sides for 40 seconds (LED Bluephase, Ivoclar Vivadent).

After cementation, occlusion was carefully checked with a focus on careful occlusal adjustment to establish canine-guided dynamic occlusion. The color of the crowns was visually evaluated, by using Vita A-D shade guide (Vita Zahnfabrik, Germany) at the beginning and during the control intervals.

Oral hygiene training was provided to all patients after cementation, and the use of a soft acrylic mouth guard was recommended for 1 month to prevent any parafunctional activity. After the placement of the restorations, the patients were seen for regular check-ups at least once per year.

Data were recorded for all patients from June 2017 to January 2018. The methods used to review and collect the data were established in a protocol and performed by a calibrated, independent observer. The data were evaluated for clinical and esthetical parameters and recorded. Clinical evaluations were performed according to the modified United States Public Health Services (USPHS) criteria. Postoperative sensitivity, marginal integrity, marginal discoloration (staining of the luting cement), color match, anatomical form, secondary caries, surface roughness, tooth integrity, restoration integrity, and mechanical accidents (eg, fissures, cracks, fractures, and debonding) were evaluated (Table 1).

Additionally, the Löe and Silness plaque index and a gingival index were used to evaluate the gingival response and were scored as 0, 1, or 2 to report the degree of patient satisfaction.

Caries, debonding, chipping, and the fracture considered absolute failures. The survival time was defined as the period from the successful fitting of the veneer restoration to the point at which the restoration presented with an irreparable problem. Survival analyses were performed with a statistical software program (SPSS 22.0; SPSS Inc., Chicago, Illinois) using Kaplan-Meier and log-rank (Mantel-Cox) tests to obtain the cumulative survival rates relative to observations.

3 | RESULTS

In this study, 413 LDSVs were placed in 51 patients, included 37 women and 14 men. The majority of the patients were between the ages of 30 and 45 years old. Only three of the treated patients were under the age of 20 years old, and four patients were over the age of 60 years old. The average age of the patients was 34.6 years

TABLE 1 The modified United States Public Health Services (USPHS) score used in this study

Category	Score	Criteria
Marginal Adaptation	0	Smooth margin
	1	All margins closed or possessing minor voids or defects (enamel exposed)
	2	Obvious crevice at margin, dentin or base exposed
	3	Debonded from one end
	4	Debonded from both ends
Color match	0	Very good color match
	1	Good color match
	2	Slight mismatch in color or shade
	3	Obvious mismatch, outside the normal range
	4	Gross mismatch
Marginal discoloration	0	No discoloration evident
	1	Slight staining, can be polished away
	2	Obvious staining, cannot be polished away
	3	Gross staining
Surface roughness	0	Smooth surface
	1	Slightly rough or pitted
	2	Rough, cannot be refinished
	3	Surface deeply pitted, irregular grooves
Fracture of restoration	0	No fracture
	1	Minor crack lines over the restoration
	2	Minor chippings in the restoration (1/4 of restoration)
	3	Moderate chippings in the restoration (1/2 of restoration)
	4	Severe chippings (3/4 of the restoration)
	5	Debonding of the restoration
Fracture of tooth	0	No fracture in the tooth
	1	Minor crack lines in the tooth
	2	Minor chippings on the tooth (1/4 of the crown)
	3	Moderate chippings of the tooth (1/2 of the crown)
	4	Crown fracture near cementum enamel line Crown-root fracture (extraction)
Secondary Caries	0	No evidence of caries continuous along the margin of the restoration
	1	Caries evident continuous with the margin
Postoperative sensitivity	0	No symptoms
	1	Slight sensitivity
	2	Moderate sensitivity
	3	Severe pain

old, and the age ranged from 18 to 68 years old. The 413 LDSVs placed on the anterior and posterior teeth in the maxillae and mandibles of 51 patients were evaluated for a mean observation time of 11.08 ± 4.85 years (min: 5 years, max: 21 years). No patients were lost to follow-up during the study. The distributions of the LDSVs according to tooth location, jaw location, preparation depth,

TABLE 2 The distribution of LDSVs according to tooth location, jaw location, preparation depth, parafunctional habits, ceramic materials, and type of resin cement used in this study

Parameters	LDSVs (n:413) Number (%)
Tooth location	
#11	43 (10.4)
#12	40 (9.6)
#13	35 (8.5)
#14	15 (3.6)
#15	9 (2.1)
#21	39 (9.4)
#22	37 (8.9)
#23	35 (8.5)
#24	15 (3.6)
#25	9 (2.1)
#31	21 (5.1)
#32	20 (4.8)
#33	19 (4.6)
#34	10 (0.2)
#41	20 (4.8)
#42	18 (4.3)
#43	18 (4.3)
#44	10 (0.2)
Jaw location	
Maxilla	277 (67.1)
Mandible	136 (32.9)
Preparation	
Enamel	398 (96.4)
Enamel Dentin	15 (3.6)
Parafunctional habits	
No	395 (95.5)
Slight (Clenching only)	18 (4.5)
Occlusion	
Class I	378 (91.5)
Class II	25 (6.1)
Class III	10 (2.49)
Materials	
Empress II	155 (37.5)
E max	258 (62.5)
Resin cements	
Variolink II	139 (33.7)
Variolink Veneer	274 (66.3)

parafunctional habits, ceramic materials, and type of resin cement used in this study are shown in Table 2.

Two hundred seventy-seven of the restorations were placed in the maxillary jaw (67.1%) and 136 (32.9%) of the LDSVs were placed in the mandibular jaw. The central incisor, lateral incisor, and canine were the most frequently restored teeth. The preparation depth was in the enamel in 398 (96.3%) of restorations, and only 15 (3.63%) of the restoration preparation depths were in both the enamel end dentin. Of the 413 LDSVs, 395 (95.6%) were placed in patients with no parafunctional habits, and 378 (91.5%) were placed in patients with a class 1 occlusion.

One hundred and fifty-five (37.5%) of the restorations were pressed with IPS Empress II, 258 (62.5%) were pressed with IPS e.max, 139 (33.65%) of the restorations were bonded with Variolink II, and 274 (66.34%) were bonded with Variolink Veneer using Syntax (a multi-component adhesive) as a bonding agent.

During the evaluation schedule, the following results were obtained:

3.1 | Periodontal tissue evaluation

3.1.1 | Plaque index

81.5% (337 LDSVs) had a value of 0, 10.9% (45 LDSVs) had a value of 1, 6.05% (25 LDSVs) had a value of 2, and only 4.21% (6 LDSVs) had a value of 3.

3.1.2 | Gingival bleeding index

76.75% (317 LDSVs) had a value of 0, 16.46% (68 LDSVs) had a value of 1, and 6.77% (28 LDSVs) had a value of 2.

3.2 | Clinical evaluation results according to the modified USPHS criteria

Slight marginal defects (recession) were found on 53 of the 413 LDSVs (12.8%) (USPHS criteria, Adaptation-Score 1), and slight marginal discoloration was observed on 48 of the 413 LDSVs (11.6%) (USPHS criteria, Marginal Discoloration-Scores 1 and 2). In the fifty-three of affected restorations, 15 LDSVs (3.63%) showed a 1 mm gingival recession; whereas only 5 (1.1%) of them had a recession of 2 mm.

No secondary caries was found in the LDSVs observed in this study.

3.2.1 | Postoperative sensitivity

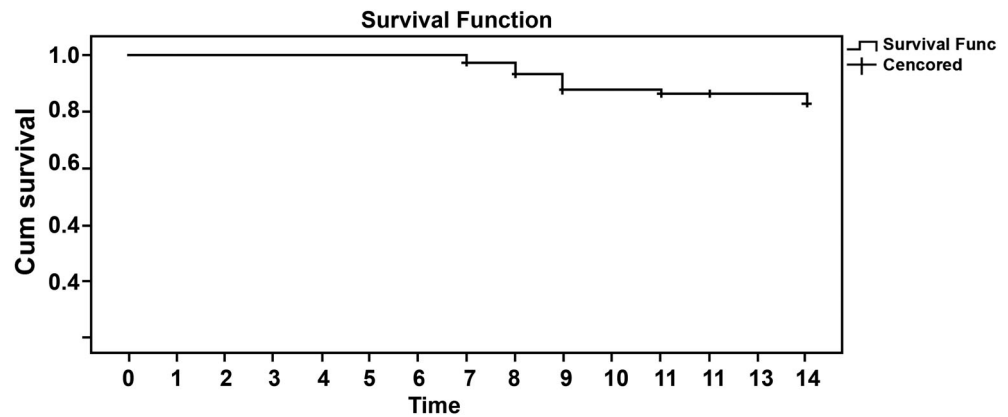
Forty-five of 413 LDSVs showed postoperative sensitivity after cementation, and the symptoms resolved in 45 after 3 weeks. Ten LDSVs showed slight sensitivity after 12 months, but this symptom later disappeared.

3.2.2 | Evaluation color/esthetic match

No color changes were observed in the restorations (USPHS criteria, Colormatch-Score 0).

TABLE 3 Failure of LDSVs according to the material, occlusion, preparation, luting agents, and parafunctional habits

Failure	Material		Occlusion			Preparation		Luting agent		Parafunction	
	Empress II	E max	CI 1	CI II	CI III	Enamel	Enamel/Dentin	Variolink II	Variolink Veneer	No	slight
Chipping/fracture (n:6)	2	4	4	0	2	5	1	1	5	3	3
Debonding (n:9)	3	6	5	1	3	6	3	2	7	4	5
Endodontic treatment (n:2)	-	2	2	0	0	1	1	1	1	2	0

FIGURE 1 Survival function of LDSVs

3.2.3 | The surface roughness (glass ceramic surface)

During the evaluations of the 413 restorations, 407 (98.2%) presented no porosity/defect/scratching or disintegration on the surface (USPHS criteria, *Surface roughness*-Score 0).

3.2.4 | Evaluation of mechanical accidents (fissures, cracks, fractures, and debonding)

A total of 15 (3.63%) LDSVs absolute failures were observed in the form of chipping and debonding. A total of 6 (1.45%) restorations showed chipping, while 9 (2.18%) of the LDSVs debonded during the entire period. Seven debonded LDSVs were occurred 1 week to 6 months after cementation. Three LDSVs were debonded at 2 and 5 years after cementation. Table 3 shows the failure type in relation to materials, occlusion, preparation, luting agents, and parafunctional habits. In this study, no relationship was found between failure and parafunctional habits, the location of the preparation, the preparation depth, ceramics (Empress II/IPS e.max), and the resin cement (Variolink II/Variolink Veneer) used ($P = .271$).

3.2.5 | Patient satisfaction

A survey was conducted in the pool of patients to determine their opinion about their restorations and to distinguish between esthetic and functional results (ie, comfort and chewing). Results were based on a scale of 0 to 10. It is found that 97.1% of the patients were comfortable with the restorations and had no problems with chewing. In the esthetic survey, 98% of the patients reported that they were satisfied with the esthetic results of the restorations.

The estimated survival rates of the 413 veneers were 98% after 5 years, 95% at 10 years, 91% at 15 years, and 87% at 20 years, indicating a very low clinical failure rate (Figure 1).

4 | DISCUSSION

It is important to note that clinical studies are necessary to evaluate the behavior of the materials being restored, given that certain intraoral conditions cannot be reproduced in a laboratory. Previous *in vivo* studies have demonstrated that ceramic veneers as an acceptable and durable restorative treatment. In this controlled clinical study, the clinical performance of LDSVs at 5, 10, 15, and 20 years after cementation was evaluated. The mean observation time was 11.08 ± 4.85 years.

The present longitudinal evaluations of LDSVs have shown that they achieve excellent results up to 20 years. The retention rate was excellent, the fracture rate was very low, and the maintenance of esthetics was superior. Overall, the survival rate of the 413 veneers was 98% after 5 years, 95% at 10 years, 91% at 15 years, and 87% at 20 years (Kaplan-Meier). Numerous longitudinal clinical studies have been performed to evaluate the behavior of ceramic veneers.^{2-4,6,7,11,13,16,22}

Most of the long-term studies reported the survival and complication rates for both feldspathic and glass ceramic veneers were 93.5% to 94.4%, 85.74%, and 82.83%, in a period of 10-, 15-, and 20-year, respectively.^{7,12,19} A study with a 10-year follow-up presented an overall survival rate of 90%.²⁰ The results of this study are similar to those in the previously reported studies by Layton and Walton,⁷ Peumans et al,²⁰ and Dumfahrt and Schäffer.⁴ The survival rates were higher in this study than in Alhekir et al,¹⁰ Granell-Ruiz

et al³² and Fradean et al⁶. The results of this study confirm the importance of experienced dentists when compared to the results of Alhekir et al's study¹⁰ reporting success rate of 65.52% when LDSVs were placed by inexperienced clinicians, indicating the technique sensitivity of procedures. Besides, Granell-Ruiz et al³² reported LDSVs survival rate of 84.7% once patients with parafunctional habits included. The present study has resulted in higher outcomes may be due to the selection criteria of the patients were more optimized.

In all, 81.5% of the LDSVs were free from the biofilm. Only 6.77% (28) of the LDSVs exhibited bleeding on probing. These results are very similar to the results reported in other studies showing that teeth restored with these types of restorations have less biofilm than those restored with other materials 20 years after restoration. These results are scientifically beneficial, considering that, the dental tissue treated with LDSVs mostly includes the dental enamel, and indicating that biofilm is quickly eliminated from these surfaces and/or the life of biofilm is significantly shorter on heat-pressed lithium disilicate ceramics.^{4,11,20,22,33} This study showed that periodontal parameters were not influenced by LDSVs and did not increase in severity over time. These optimal periodontal conditions indicate that the preparation procedures were entirely respectful of the patients' periodontal tissues.

Only 4.63% of the restorations showed signs of gingival recession in this study, similar to the results reported in Granell-Ruiz et al³². Dumfahrt and Schäffer⁴ found a rate of gingival recession of 30%, and they justified this result by explaining that recessions are frequent in patients with good oral hygiene and the proportion of individuals with recessions increases with age. In this study, the gingival recession was found in patients over 50 years old, similar to the results in Dumfahrt and Schäffer.⁴ Given that his study was carried out over a prolonged period, those recessions may be considered a consequence of the passage of time.

No secondary caries was found in this study. Dumfahrt and Schäffer⁴ also reported finding no secondary caries in their studies. Other studies^{33,34} have reported that the percentage of patients with caries was between 1% and 2%. Granell-Ruiz et al³² observed caries in 10 of restorations performed in 7 patients, indicating a relatively high percentage (3.1%), during their study period. The difference between these and our results may be explained by the fact that this study was a controlled study, and patients were given oral hygiene education during all recall studies.

The color of the LDSVs was evaluated, with a score of 0 achieved in all cases. Also, none of the glass ceramic surfaces of any of the restorations presented any porosity/defect/scratching or disintegration on the surface. These perfect results might be due to the lithium disilicate materials, indicating that monolithic lithium disilicate exhibits stable color behavior.^{36,37}

It is critical for the dentist to understand that the preparation design has a substantial influence on the restoration survival rate and the success of the therapy. Most authors recommend preparation designs in which the incisal edge is reduced.^{27-29,39-41} In the present study, all restorations were prepared using a butt joint design with 1-1.5 mm incisal reduction. Castellnuovo et al²⁸ reported that the butt joint increased tooth-ceramic bonding as a result of preserving the

peripheral enamel layer around all margins and therefore eliminating microleakage especially at the palatal tooth-restoration interface owing to better shear stress distribution.

Also new contemporary bonding systems provide strong resistance, and the presence of enamel affects bonding strength^{12,18,29} and provides stiffness and rigidity. An optimal bond is obtained if the preparation is entirely located in the enamel, if suitable surface treatment procedures are performed, and if the correct composite luting agent is selected. Gurel et al¹² found an intraoral 12-year survival rate of 99% for porcelain laminate veneers with an enamel-based preparation design. The results of this study are in agreement with those of Gurel et al's¹² studies. In the present study, only 2.18% of the restorations showed debonding during the follow-up period. The number of debonding found in the present study was also relatively lower than those reported in Dunne,² Granell-Ruiz et al,³² and Shaini et al³³. They reported high incidences of debonding of restorations due to the existence of composite reconstructions on the teeth and the inclusion of patients with bruxism and less enamel, in whom the restorations must be cemented. Peumans et al²⁰ stated that predisposing factors for the occurrence of fractures include partial adhesion to a dentin surface, the presence of large composite restorations, bonding to endodontically treated teeth and heavy mechanical loading during occlusion. Thus, the reasons for the few debonding occurrences in the present study may be that the patients with bruxism, extensive composite restorations or insufficient enamel were not included.

During the study period, less than 5% of the restorations failed as a result of chipping/fracture and debonding. Beier et al¹¹ reported a low failure rate (7.2%) as a result of fracture/chipping (3.4%) and debonding (2.0%) during the evaluation period used in their study. Additionally, Friedman³ followed up 3500 porcelain veneers over 15 years and found a 7% failure rate. Most other clinical studies have also reported a low failure rate resulting from a 1% to 5% fracture rate.^{10,12,13,16}

The vast majority of studies performed to evaluate ceramic veneers have shown that the level of patient satisfaction is high. In the present study, 97% and 98% of the patients were satisfied with the esthetic and functional outcomes, respectively, and no adverse effects on gingival health were reported in patients with sufficient oral hygiene. The results of the present study are very similar to those reported by other authors.^{20,31}

The reason for highly successful outcomes was due to detailed exclusion patient selection criteria and also the low complications seen in this study attributed to the fact that experienced specialists kept the preparations mostly in enamel and used a butt joint design preparation. An experienced dental technician using pressable LDS system might also have contributed to the fracture resistance of the restorations.

5 | CONCLUSION

With up to 20 years of clinical service, this study indicates that LDSVs are a reliable, effective, and conservative treatment option for restoring

teeth in the esthetic zone. The long-term esthetic and functional success of LDSVs is excellent, and if indications are carefully observed, the prospects for long-term success are very high.

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