



Conservative Management of Uneven Anterior Teeth Spacing using Lingual Porcelain Laminate Veneers: Report of Two Cases with 2- and 6-year follow-up

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ABSTRACT

Porcelain laminate veneers (PLV) offer a conservative aesthetic solution for interdental space closure. However, space is typically not distributed symmetrically, and the mesiodistal width of the restored teeth may increase unless multiple teeth are prepared for conventional PLV to maintain appropriate individual tooth proportion. Ceramic fragments can be suggested to close the space without modifying tooth size and dental proportion. This article presents two cases where interdental gaps were closed using lingually placed porcelain laminate (LPPL). All stages of the restorative procedures, including treatment planning, temporization, tooth preparation, and cementation of these delicate restorations, are detailed. Based on the results of these clinical reports, we regard the use of LPPL as a successful treatment option in selected cases, as evidenced by 2- and 6-year follow-ups. The Modified United State Public Health Criteria is reported.

Keywords: Diastema; Dental Porcelain; Esthetics, Dental; IPS-Empress Ceramic

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INTRODUCTION

Every patient desires a healthy and aesthetically appealing smile. Diastema and tooth size discrepancy are among the reasons for which a patient seeks aesthetic dental treatment [1]. Uneven interdental spacing between anterior teeth is considered a challenge for correction using a restorative approach, as it may complicate the achievement of well-proportioned anterior teeth. In such instances, an interdisciplinary approach, including orthodontic treatment and restorative dentistry, might be necessary [2].

Direct resin composite and porcelain are the most frequently used veneering restorative materials for conservative space closure, and PLVs are considered to be one of the most viable

treatment options for closing diastema [1, 3, 4]. However, space closure using a restorative approach is challenging if the space is not symmetrically distributed. The first dilemma is the mesiodistal enlargement of the restored teeth [5]. A more aggressive restorative approach, including several anterior teeth for conventional porcelain laminate (CPL), might be necessary to maintain individual tooth proportion [1]. To avoid cutting away healthy tooth structure and tooth size discrepancy, ceramic fragments can be proposed to modify tooth size without dental preparation for irregular interdental space closure [6-8]. Minimally-prep lingually placed porcelain laminate (LPPL) with an extension into lingual and proximofacial line angles can

be designed in selected cases when there is adequate interocclusal clearance to close the gaps without covering the incisal edge. This porcelain laminate design might be indicated for space closure of mandibular and maxillary anterior teeth and premolars. Another concern using CPL on anterior teeth is the potential abrading of opposing tooth structures against which they occlude, which could be avoided using the LPPL [9, 10].

A concern might arise with the marginal discoloration of LPPL on cavosurface margins, however, several clinical studies reported a successful clinical performance of CPL according to Modified United States Public Health Service (USPHS) and Fédération Dentaire Internationale (FDI) World Dental Federation clinical criteria (FDI) that included cavosurface marginal discoloration over several years [11-16].

In these case reports, LPPL for two patients with aesthetic problems related to the interdental spaces between maxillary and mandibular anterior teeth are described, and success with 2 and 6-year follow-up is presented.

MATERIALS AND METHODS

Case 1

A 30-year-old woman was admitted to the Restorative Dentistry Department of Tehran University of Medical Sciences School of Dentistry, complaining about the existing spaces between the upper anterior teeth. The clinical examination revealed interdental spacing between lateral incisors and canines (Figure 1a-1b). The dental midline coincided with the mid-sagittal plane. Vertical and horizontal overlap were 1.5mm and 2mm, respectively. The patient had canine-protected occlusion. A comprehensive oral examination was undertaken.

On the first visit, an alginate impression of both maxillary and mandibular arches was taken, and dental casts were mounted on a semi-adjustable articulator. At the diagnostic stage, laboratory composite veneers were prepared on the lateral incisors, which appeared bulky with undesirable tooth size disharmony compared to the adjacent teeth.

To avoid bulky lateral incisors, the lateral incisors were lingually covered with an

extension to the distofacial line angles instead of covering the tooth labially. A silicone impression was then developed from it, and in the mock-up session, temporary resin material shade A2 (Kettenbach, Eschenburg, Germany) was inserted into the silicone mold. After its removal, the mock-up resin shells were evaluated for their width and proportion. The influence of additive tooth volume on phonetics was also assessed. At this step, the centric stop, protrusive excursions, and laterotrusive movements were evaluated. The emergence profile of the cervical margins of the teeth was also assessed. The cosmetic mock-up gave the patient a three-dimensional view of her new smile before starting the final treatment.

The shade of the sectional veneers was determined prior to making a definitive impression with polyvinyl siloxane material (Kettenbach, Eschenburg, Germany). A dimple was prepared using a round-end diamond (D&Z, Berlin, Germany) on the palatal surface of the lateral incisors to provide an adequate seat and keep the restorations in position during the cementation step. Despite the absence of a finish line preparation, a gingival retraction cord (Ultrapak, Ultradent, USA) was used to obtain a better emergence profile for the veneers.

The dental laboratory constructed ceramic

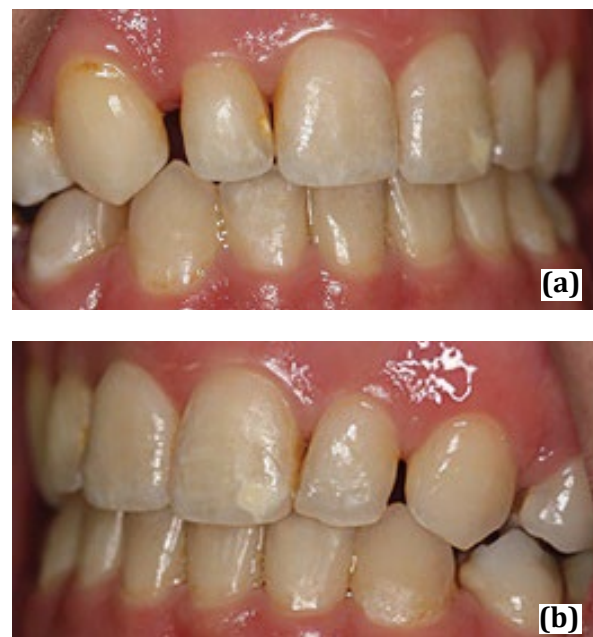


Fig. 1. Lateral view of anterior dentition on the right (a) and left (b) sides

LPPL with a thickness of less than 1mm for the upper maxillary lateral incisors with IPS e.max lithium disilicate glass-ceramic (Ivoclar-Vivadent, Schaan, Liechtenstein) (Figure 2a). Before cementation, the marginal adaptation of LPPL was evaluated, and a colorless (transparent) luting agent (Rely X, 3M, ESPE, USA) was selected. The fit surfaces of the veneers were first etched for 20 seconds with 9.6% hydrofluoric acid gel (Ultradent, South Jordan, UT, USA) and rinsed off. Then, 35% phosphoric acid (Ultra-etch, Ultradent, South Jordan, UT, USA) was applied for 1 minute, followed by rinsing under running water for 1 minute and ultrasonic cleaning in distilled water for 5 minutes to remove white residue metallic salts[19], and drying with oil-free air. It was then silanized with a ceramic primer (Rely X, 3M ESPE, USA), and a single coat of a bonding resin (Clearfil SE Bond 2, Kuraray Noritake Dental Inc., Tokyo, Japan) was applied and thinned out but not light-cured at this time. Dental prophylaxis was performed using a bristle brush, pumice paste, and water. The distal and palatal surfaces of the lateral incisors were etched with a 35% phosphoric acid agent for 30 seconds, followed by rinsing with water and gentle air drying for 15 seconds. Then, a single coat of the bonding resin was applied and not light-cured. The luting cement was applied

to the internal surfaces of the veneers. They were gently seated on the palatal surface and held in place. The luting resin was briefly light-cured from the buccal surface. The restoration margins were covered with glycerin gel to prevent the formation of an oxygen-inhibited layer. The luting agent was then light-cured for 60 seconds on each surface of the restoration by means of an LED light-curing unit with a light intensity of 980mW/cm² (Elipar Free Light 2, 3M ESPE, USA). Figure 2 shows the final palatal view after the placement of LPPL.

Occlusion was evaluated. More than a 1mm horizontal overlap was presented between the restored lateral incisors and the opposing mandibular incisors. There was no contact at maximum intercuspation on the restored lateral incisors, and it is worth noting that the canine-protected occlusion provided no interference on the lateral incisors at all excursive movements of the mandible. The patient's aesthetic expectations were met, and she was happy with the aesthetic outcome after a 2-year follow-up (Figures 2b, 3a-3b).

Case 2

A 45-year-old woman, complaining about the spaces between the lower anterior teeth, was referred. The interdental spacing was between #32, #31, and #41, not appreciable during speech or smiling (Figure 4). The clinical



Fig. 2. Porcelain laminate veneers (a) and occlusal view of the palatally placed porcelain laminate veneers on the upper right and left lateral incisors (b)



Fig. 3. Close-up view of upper right incisors (a) and close-up view of upper left incisors (b), after 2-year follow-up



Fig. 4. Frontal view of anterior dentition.



Fig. 5. Porcelain laminate veneers (a) and frontal view of lingually placed veneers on mandibular central incisors (b) after 2-year follow-up

examination revealed a healthy periodontium and a class I canine relationship. She had a 1.5mm overbite and a 1mm overjet.

Several treatment plans were developed and presented to the patient. She rejected prior orthodontic treatment or full-ceramic crowns or CPL to avoid preparation of the healthy tooth structure. A direct mock-up with composite resin was performed to simulate the proposed LPPL. The restored teeth in maximum intercuspation and in all excursive movements were adjusted, and phonetics were evaluated. The patient was satisfied with the result and consented to the treatment planning. During the second appointment, shade selection was performed, and the incisal third of the proximal walls of the mandibular central incisors was slightly removed to permit the final LPPL seat along a definite path of insertion. Then, silicone impressions from both jaws were made. LPPL



Fig. 6. a) Frontal view of lingually placed veneers on mandibular central incisors (a) and close-up view of lower incisors (b), after 6-year follow-up

were prepared on the lingual and mesial surfaces of #41 and covered both mesial and distal sides of #31 without covering the incisal edges (Figure 5a).

At the cementation appointment, the LPPL were tried in for shade, fit, marginal adaptation, shape, size, and symmetry. The patient's approval was obtained at the time of try-in. The previously explained cementation procedure was followed step by step. Patient follow-up was done at one month, and after 2 years. The patient was satisfied with the teeth appearance, color, and alignment after a 2 and 6-year follow-up (Figure 5a, 6a-6b). However, stain and calculus were apparent on the incisors and required to be removed. The USPHS criteria of the two presented cases are shown in Table 1.

DISCUSSION

These case reports describe a conservative approach for the closure of an unsightly space between the teeth in the smile zone to restore aesthetics in a minimally invasive approach. Various treatment approaches were considered, including an orthodontic treatment option, which was immediately refused due to its long duration and higher expenses. The patients were more interested in alternative approaches that would be less time-consuming but still aesthetic without any tooth scarification. In view of this, a minimally invasive approach of LPPL was proposed, and a schematic description of the clinical procedures was presented to the patients. PLVs

Table 1. Modified United States Public Health Service criteria used for restoration assessment [22,23]

Category	Definition	Case 1		Case 2	
		2y F/U	2y F/U	2y F/U	6y F/U
Color Match	Alpha (A)	Restoration matches the shade and translucency of adjacent teeth			
	Bravo (B)	Restoration does not match the shade and translucency of adjacent teeth, but the mismatch is within the normal range of tooth shades	21*	31	31
	Charlie (C)	Restoration does not match the shade/translucency of adjacent teeth and the mismatch is outside the normal range of tooth shades/translucency	22	41	41
Cavosurface Marginal Discoloration	Alpha (A)	No visual evidence of marginal discoloration different from the color of the restorative material and from the color of adjacent teeth			
	Bravo (B)	Visual evidence of marginal discoloration at the junction of the tooth structure and the restoration, but the discoloration has not penetrated along the restoration in a pulpal direction	21	31	31
	Charlie (C)	Visual evidence of marginal discoloration at the junction of tooth structure and restoration that has penetrated along the restoration in a pulpal direction	22	41	41
Secondary Caries	Alpha (A)	Restoration is a continuation of the existing anatomic form adjacent to the restoration	21	31	31
	Bravo (B)	Visual evidence of dark discoloration adjacent to the restoration but not directly associated with cavosurface margins	22	41	41
Restoration Integrity	Alpha (A)	No material defect or crack	21	31	31
	Bravo (B)	Two or more cracks not compromising marginal integrity or contacts	22	41	41
	Charlie (C)	Restorative fractures compromising marginal integrity or contacts			
Marginal Adaptation	Alpha (A)	The explorer does not catch when drawn across the surface of the restoration toward the tooth, or, if the explorer does not catch, there is no visible crevice along the periphery of the restoration.	21	31	31
	Bravo (B)	The explorer catches and there is visible evidence of a crevice, which the explorer penetrates, indicating that the edge of the restoration does not adapt closely to the tooth structure	22	41	41
	Charlie (C)	Explorer penetrates crevice defect			
Surface Texture	Alpha (A)	Surface texture similar to polished enamel as determined by means of a sharp explorer	21	31	31
	Bravo (B)	Surface texture gritty or similar to a surface subject to a white stone or similar to a composite containing supramicron-sized particles.	22	41	41
	Charlie (C)	Surface pitting is sufficiently coarse to inhibit the continuous movement of an explorer across the surface			
Gross Fracture	Alpha (A)	Restoration is intact and fully retained	21	31	31
	Bravo (B)	Restoration is partially retained with some portion of the restoration still intact	22	41	41
	Charlie (C)	Restoration is completely missing			

F/U: follow-up

*The numbers refer to the tooth numbering based on FDI tooth numbering

are thin shells of ceramic, take up the strength of enamel, and become as strong as the natural tooth structure when bonded to enamel [14, 15]. They resist staining, provide a smooth and impervious surface not picking up stain from richly colored foods [17].

LPPL was considered to be more conservative for closing the spaces while maintaining aesthetic tooth proportions compared to the use of CPL in unevenly distributed interdental spacing.

Closing the space from the lingual aspect gave the illusion of a narrower facial profile while deepening the facial embrasure. Furthermore, extension onto the lingual surfaces increased the surface area for bonding and provided additional stability and orientation during veneer insertion. Innovative preparation designs of porcelain laminate have emerged and have been explained in several clinical reports [6-8,18]. Signore A. et al [6] reported a case of a maxillary midline diastema closure by means of sectional porcelain veneers simply cemented over the entire proximal surface without any prior tooth preparation. Farias-Neto A. et al [7] also reported a case with a large incisal embrasure between central incisors treated using minimally invasive adhesive restorations. No-prep veneers and ceramic fragments were prepared and cemented on the mesial-incisal angle of the upper central incisors [7]. A recent clinical study proposed promising results in a short to medium term for sectional veneers [19].

Chen CT et al. reported slight to moderate cervical marginal staining of sectional feldspathic porcelain veneers on maxillary incisors after a four-year follow-up in two cases among five treated female patients [19]. Durán Ojeda G et al. conducted a retrospective study on 79 partial laminate veneers for 8 years, and the quality of the restorations was evaluated using USPHS criteria. The cumulative survival rates were 100% after 1 year, 95.9% and 61.4% after 5 and 8 years, respectively. Marginal discoloration and color mismatch occurred in 4.2% of cases after an 8-year follow-up. Fracture was observed only in 16.7% of cases [20]. A literature review on the sectional veneers revealed that few clinical studies have investigated the clinical performance

of this type of restoration. The short-term evaluations demonstrated similar short-term clinical performance with conventional ceramic laminate veneers, but with no or ultra-conservative preparation [21].

In the present study, LPPL were designed for space closure of irregular dental spacing to avoid imbalance in the tooth proportion of the anterior teeth. Careful attention was paid to details of creating an interproximal emergence profile by the technician to limit any potential overhang of the restorative material. The proximal part of the veneer seamlessly blended into the tooth structure.

After a 2 and 6-year follow-up, no clinical evidence of failure like fracture or unpleasant marginal discoloration was evident. The long-term clinical results for this new technique are not yet available. Longitudinal multiple case studies will provide additional data to support the clinical effectiveness of LPPL. They can be indicated for selected cases where strict criteria are met. Also, the success of this type of restorative procedure depends on the correct treatment plan conducted by the clinician in conjunction with the technician.

CONCLUSION

The two case reports described the closure of irregular interdental spacing of maxillary and mandibular anterior dentition with lingually placed porcelain veneers after minimal preparation. This laminate design may represent a suitable alternative to conventional porcelain laminate veneers in selected cases.

CONFLICT OF INTEREST

There is no conflict of interest regarding the publication of this article.

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