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## Transformation of teeth by using porcelain laminate veneers designed by diagnostic additive wax-up and resin composite mock-up

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### Abstract

**Objectives:** Cuspids migrated medially into the position of lateral incisors create unpleasant esthetic appearances. This kind of a situation and the related disturbances such as the diastemas and the positional and/or proportional irregularities, create major challenges in front of the dental practitioners.

**Materials and Methods:** The diagnostic additive wax-up, gingival esthetic recontouring, vacuum formed clear template, resin composite mock-up, silicone index, conservative preparations and luting procedures for transformed porcelain laminate veneers used for the esthetic rehabilitation of a patient presenting misplaced lateral incisor and cuspid, and polydiastema, were presented.

**Results:** Anterior esthetic appearance was restored satisfactorily and the restorations are still functioning free of any postoperative complication after 3-years of follow-up.

**Conclusions:** Preoperative designing approaches such as additive wax-up and resin composite mock-up made by the clear template and the use of the silicone index as a preparation guide; were found successful applications for improving the esthetic appearance of the anterior dentition and the changing of the tooth form by using porcelain laminate veneers.

**Clinical Relevance:** Tooth morphology may be transformed into another tooth by using porcelain laminate veneers and preoperative planning guarantees the final success and the patient satisfaction.

**Keywords:** Tooth transformation; Porcelain laminate veneer; PLV; mock-up; Additive wax-up

### 1. Introduction

Porcelain laminate veneer (PLV) restorations have gained increasing popularity for esthetic improvement of anterior teeth. They have been reported to be conservative and durable anterior restorations with superior esthetics [1, 2].

Design principles and the tooth preparation methods for PLVs were described in detail by several reports and simplified techniques included the use of depth cutters guided by the existing tooth surface, were evaluated [3].

More recent and sophisticated methods have integrated an additive diagnostic procedures such as the wax-up or mock-up, to compensate for tooth aging or severe existing loss of tooth substance and driven by the final volume of the restoration were described by Magne and Belser [4]; and reported as provide more enamel preservation and as a consequence, more predictable bonding, biomechanics, and esthetics [5-11].

The treatment of discoloured, fractured, worn, or congenitally malformed teeth, as well as esthetic reshaping of anterior teeth and elimination of diastemas once requiring full-coverage restorations are accomplished with the use of PLVs [12-29].

Prosthetic treatment of a patient exhibiting the lateral incisor and cuspid replaced by each other in the right maxillary region and accompanying unsightly appearance due to the proportional irregularity of the length and the width of the clinical crowns. Transformed PLVs designed by diagnostic wax-up and mock-up; were used for this purpose. Mentioned techniques were described in this clinical report.

### 2. Clinical Report

A 20 years-old female was attended with the anterior esthetic complaints. General health status was fair. Intraoral and radiological examinations revealed that teeth were sound and free from carious lesions. Muco-gingival status was also good. However an unsightly replacement between the maxillary right lateral incisor and cuspid was noticed. Polydiastema were present,

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and the proportional irregularity of the remaining anterior dentition posed a negative effect on the smile of the patient (Fig 1, 2). Unilateral balanced occlusion was observed but the canine guidance was lost due to the unusual position of the medially disposed cuspid. Central incisors were guiding the protrusive movement of the mandible properly.



**Fig 1:** Anterior appearance of the patient. Note the replacement between the lateral incisor and cuspid on the right side and polydiastema.



**Fig 2:** Unfavorable interrelation between the anterior dentition and the lips.

PLVs were planned to improve the anterior esthetics. Transformation of the right maxillary cuspid into a lateral incisor and lateral incisor into a cuspid were planned. Morphological improvement of the remaining anterior teeth and closing of the polydiastema were also included to the treatment plan.

Preliminary impressions made with stock trays and irreversible hydrocolloide impression material (CA-37, Cavex Dental BV, Haarlem, Holland). Impressions were poured in dental stone (Gilodur, Giuliani Chemie; Ludwigshafen, Germany) and the diagnostic casts were obtained.

Diagnostic wax-up was made with white modelling wax (Pro-Art IPS Empress Wax, Ivoclar Vivadent; Schaan, Liechtenstein). Analysis of the diagnostic wax-up showed that, inciso-gingival lengthening of the teeth and the marginal gingival corrections were required. After the indexing and the modifying of the diagnostic cast, wax-up was remade. Afterwards, it was duplicated in dental stone (Gilodur, Giuliani Chemie) by using irreversible hydrocolloide impression material (CA-37, Cavex Dental BV). A clear resin template was vacuum- formed and trimmed.

Recontouring of the marginal gingiva was performed and the optimal tissue healing was obtained (Fig 3). Teeth were spot-etched at the mid-point of the facial surface with 37% orthophosphoric acid (Totaletch, Ivoclar-Vivadent) for 10 s, rinsed, and dried. Template was filled with flowable resin (Tetric Flow, Ivoclar-Vivadent) and applied on the teeth (Fig 4). Excess material was swept-off from the borders. Material was light polymerized with an energy density of 480 mW/cm<sup>2</sup> (Optilux, Demetron; Danbury, CT, USA) for at least 40s from labially and palatally. The template was peeled-out and the composite mock-up was uncovered (Fig 5).



**Fig 3:** Surgically recontoured marginal gingiva.



**Fig 4:** Application of the template on the unprepared teeth.



**Fig 5:** Resin composite mock-up.

Composite mock-up was let to stay in mouth for a week and improved with the composite additions and trimmings. After the establishment of the balanced red and white esthetics and acceptance of the final smile design, a silicone index was made from the putty elastomeric impression material (Stabilis Putty, Cavex Dental BV). Impression was taken out from the tray and the incisal region was cut-off. Teeth were prepared as to maintain a sufficient and balanced space between the preparation surface and the index (Fig 6). Supragingival chamfered cervical finishing lines; proximal feathers, incisal overlaps and smooth margins were created. To obtain optimal gingival displacement, a retraction cord #00 (Ultrapack, Ultradent; Salt Lake City, UT, USA) soaked with hemostatic solution (20% ferric sulphate solution ViscoStat, Ultradent) was used.



**Fig 6:** Sufficient and balanced clearance between the silicone index and the prepared teeth surfaces.

Vacuum-formed transparent template was also used for the temporization. It was filled with a flowable composite resin (Tetric Flow, Ivoclar-Vivadent) and light cured. Subsequently, the provisional restorations were cemented with eugenol-free temporary cement (Temp-Bond NE, Cavex Dental).

Impressions were made with a vinyl polysiloxane elastomeric material (Pentsoft Duo-Mix, 3M ESPE; Seefeld, Germany), mixed by an automatic mixer (Pentamix, 3M ESPE) and put on individual trays. Master casts were poured with a Type IV dental stone (Glastone Dental Stone, Dentsply; Milford, DE, USA). An irreversible hydrocolloid material and the stock tray were used for the impression of the opposing dentition and interocclusal registration was also made.

PLVs were made of a heat-pressed ceramic material (IPS e-max Press, Ivoclar-Vivadent). Veneers were manufactured slightly lighter than lower anteriors in order to patient's expectations. Intaglios were sandblasted with 50- $\mu\text{m}$   $\text{Al}_2\text{O}_3$  particles (Korox, Bego, Bremen, Germany), etched for 40 s with 9.5 % hydrofluoric acid (Porcelain Etch, Ultradent), rinsed and cleaned ultrasonically first in detergent solution and then in distilled water by using an ultrasonic cleaner (Sonorex; Bandelin, Germany), dried, and silanized (Silane, Ultradent).

Provisional restorations and temporary cement remnants were eliminated from prepared tooth surfaces. Teeth were cleaned with nonaromatic pumice and rinsed. Moisture control was established. Prepared surfaces were etched with 37% orthophosphoric acid (Ultraetch, Ultradent) for 10 s, rinsed, and dried. A dentin-bonding agent (Excite, Ivoclar-Vivadent) was used before cementation when dentin was exposed. The restorations were cemented with a dual-curing resin-cement (Variolink II, Ivoclar Vivadent). Color matching of the

prepared teeth was performed according to the manufacturer's instructions. Excess cement was removed after 10 s of preliminary light polymerization, and the restorations were then completely light polymerized with an energy density of 480  $\text{mW}/\text{cm}^2$  (Optilux, Demetron) for at least 120s from all aspects of the tooth. The patient was instructed about the use of her laminate veneers and was recalled 1 week later to assess the oral hygiene and gingival response (Fig 7, 8).



**Fig 7:** Finished restorations. Polydiastemas were closed, proportions were improved, right cuspid was transferred to lateral incisor and the distally neighboring lateral incisor was transferred to a cuspid.



**Fig 8:** Renewed smile of the patient.

### 3. Discussion

Varying types of dental problems solved by PLVs, were described in several reports. Conservative use of porcelain laminate veneers provides satisfactory esthetic outcomes and preserves sound structures of the discoloured teeth [12-16]. The properties of dental ceramic such as colour stability, mechanical strength, clinical longevity, esthetic appearance and compatibility with periodontal tissues-make this material a good choice for such treatment [12]. Malformations such as conoid teeth, peg laterals and/or microdontia, may successfully be treated by PLV restorations [17-20]. An accurate diagnostic and interdisciplinary approach was advised for obtaining improved, conservative and predictable esthetic results in esthetically compromised areas, such as the anterior maxillary dentition [17]. The closure of anterior maxillary diastemas can be accomplished in several ways. And the PLV is one of the most favorites [21, 22]. Fixed prosthodontic treatment of the amelogenesis imperfecta cases exhibiting discoloured and mutilated teeth and anterior open bite was performed and the

patient's esthetic and functional expectations were successfully attained with porcelain laminate veneers according to the related literature [23, 24]. Incisal lengthening and recontouring of the worn dentition by using PLVs [25] and the prosthetic reconstruction of the fracture originated dental displacements with PLVs [26] were found in reviewed literature. PLVs were also advised for young adult patients in need of esthetic restorations [27] and for advanced corrections following orthodontic treatment [28]. Tooth transformations should also be included to the mentioned indications. According to Griffin [18] when one type of tooth is transformed into another through the restorative process, special care must be taken to ensure correct preparation and gingival contours to create the illusion that the teeth are in their correct position.

Two teeth were transformed in present case. Maxillary right cuspid transformed into a lateral incisor and the lateral incisor neighboring laterally, transformed into a cuspid. Diastemas were also closed in order to improve the esthetic appearance. The extensions of PLV in diastema closure have more of an esthetic than functional consideration according to Chander and Phadmanaban [21]. They reported the angulations and the loading level, as the critical factors acting on the free extension of the PLV [21]. The closure of anterior maxillary diastemas can be planned and the tooth widths might be calculated from the tables of mean measurements [22]. However in present study, diagnostic wax-up and mock-up applications were preferred for the preoperative planning.

Magne and Magne [5] reported that; a preliminary restorative goal is obtained primarily by the addition of wax to the preliminary model. This procedure requires a precise knowledge of the strategic elements of tooth anatomy, but also intuition, sensitivity, and a good perception of the patient's individual personality, which usually requires a direct relationship between the patient and dental technician. Additionally, the diagnostic wax-up guided the crown-lengthening surgery by showing the most effective proportions. Malik and Tabiat-Pour [29] reported that, crown-lengthening surgery consists of recontouring and repositioning the gingival margin as well as the alveolar crest. Increase of the clinical crown height of teeth, which can consequently be advantageous in terms of improving retention and resistance, as well as aesthetics. They demonstrated the use of the diagnostic wax set-up for the process of obtaining consent, as well as acting as a useful guide for gingival and osseous recontouring in order to achieve a predictable, healthy and stable dento-gingival complex with pleasing aesthetics and a well-made diagnostic wax-up can provide valuable information to the dentist, laboratory, and patient which can be otherwise difficult to communicate [29].

In present study, a clear template was vacuum-formed on the dental stone duplicate of the wax-upped diagnostic cast. Mock-up was made with flowable resin composite by using the template. Auto polymerizing methacrylates were advised for mock-up in some studies [4-7]. Resin composite materials were also advised, especially with direct intra-oral methods [8-11].

Following final corrections, silicone index was made as described in previous reports [2-4, 8-11]. Preparations were performed with the guidance of the silicone index. Magne and colleagues [4, 5, 7, 8] reported that, use of a silicone index made by the clear template, clinicians should be able to perform tooth preparations that are both more accurate and also higher in quality in an extremely time-efficient fashion compared with traditional methods.

Techniques employed in this study; preoperative additive wax-up, composite mock-up by using a clear template and silicone

key as a preparation guide, were found useful for tooth transformation via PLVs. However, described techniques were not limited with tooth transformation cases. May successfully be used for reshaping of the tooth forms in various cases.

#### 4. Conclusions

Under the lights of the present paper, following conclusions were withdrawn: with esthetic and functional demands, teeth may be transformed into another conservatively by using PLV's.

Diagnostic wax-up enhances the predictability of treatment by modeling the desired result and the desired gingival margin location in wax prior to treatment.

Duplication of the waxed diagnostic cast with dental stone is easy, quick and inexpensive. Also it is necessary for the vacuum-forming procedure.

Vacuum-formed clear template facilitates the production of the mock-up.

Resin composite mock-up provides patient feedback and may be improved intraorally.

Mock-up driven preoperative planning and preparation provides satisfactory esthetic outcomes and preserves sound tooth structure in PLV applications.

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