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Case Series

# Anterior Esthetic Rehabilitation with Digitally Designed and CAD/CAM-Fabricated Lithium Disilicate Laminate Veneers - A Case Series

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## ABSTRACT

Anterior aesthetic rehabilitation requires precise evaluation of tooth proportions, smile dynamics, facial harmony, phonetics, and patient expectations. The integration of digital smile design, intraoral scanning, Computer-Aided Design and Manufacturing (CAD/CAM), and intraoral mock-up has enabled a more predictable and patient-centred approach to aesthetic treatment. This case series presents the management of two patients with maxillary anterior midline diastema using a digitally integrated workflow. A 35-year-old male presented with an approximately 3-mm midline diastema associated with anterior tooth attrition, while a 29-year-old female presented with an approximately 2-mm midline diastema and desired an early aesthetic correction. High-resolution photographic and videographic records were obtained, followed by digital intraoral scanning and virtual designing using Exo cad software. A digital mock-up was developed and transferred intraorally using a three-dimensional printed model, putty index, and provisional bis-acryl resin. This enabled both patients to visualize and evaluate the proposed aesthetic outcome before irreversible tooth preparation. Following patient and clinician approval, the definitive restorations were digitally designed and CAD/CAM fabricated using lithium disilicate ceramic. The veneers were evaluated intraorally and adhesively bonded using a resin cement following appropriate ceramic and tooth-surface conditioning protocols. The described workflow facilitated enhanced clinician–patient communication, allowed modification of the proposed restoration before irreversible intervention, and provided a streamlined transition from digital planning to definitive restoration.

***Keywords****: digital smile design; laminate veneers; lithium disilicate; CAD/CAM; intraoral scanning; dental diastema; aesthetic dentistry; digital workflow; mock-up.*

## INTRODUCTION

Aesthetic rehabilitation of the maxillary anterior region is one of the most demanding procedures in contemporary restorative and prosthodontic dentistry. Successful treatment involves more than correction of tooth morphology; it requires harmonious integration of tooth dimensions, alignment, colour, gingival architecture, smile line, facial proportions, phonetics, and patient expectations. Midline diastema is a common anterior aesthetic concern and may arise from several etiological factors, including developmental variations, tooth-size discrepancies, abnormal frenum attachment, missing or undersized teeth, and parafunctional or other acquired conditions. Treatment planning should therefore be based on an appropriate diagnosis and individualized assessment of the patient's expectations. The present case series describes the management of two patients with maxillary anterior midline diastema using a digitally integrated workflow involving intraoral scanning, virtual designing, digital mock-up, intraoral temporization, patient approval, and CAD/CAM-fabricated lithium disilicate laminate veneers.

## CASE PRESENTATION:

### Case 1

A 35-year-old male patient reported to the Department of Prosthodontics, Crown and Bridge, Government Dental College and Hospital, Srinagar, with a chief complaint of spacing in the maxillary anterior region. The patient expressed considerable concern regarding the appearance of his anterior teeth and desired aesthetic correction. Clinical examination revealed an approximately 3-mm midline diastema between the maxillary central incisors. Attrition involving the maxillary anterior teeth was also observed. A comprehensive clinical examination was performed, including evaluation of tooth morphology, periodontal status, occlusion, smile characteristics, and phonetics. The available treatment options were explained to the patient, including their advantages, limitations, treatment duration, maintenance requirements, and expected aesthetic outcome. Following patient counselling and informed consent, aesthetic rehabilitation using digitally designed laminate veneers was planned.

### Case 2

A 29-year-old female patient reported to the Department of Prosthodontics, Crown and Bridge, Government Dental College and Hospital, Srinagar, with a chief complaint of spacing in the maxillary anterior region. The patient was concerned about the appearance of her anterior teeth and specifically desired an early aesthetic correction. She did not wish to undergo a treatment modality requiring prolonged treatment duration. Clinical examination revealed an approximately 2-mm midline diastema between the maxillary central incisors. The patient's expectations, available treatment options, advantages, limitations, and anticipated outcome were discussed. Following comprehensive counselling and informed consent, anterior aesthetic rehabilitation using digitally designed laminate veneers was planned.

## CLINICAL PROCEDURE:

A standardized digital workflow was followed for both patients.

### Initial Records and Digital Data Acquisition:

Written informed consent was obtained from each patient before treatment. High-resolution intraoral and extraoral photographs and videographic records were obtained according to the digital aesthetic planning protocol (Fig 1). The photographic records were used for assessment of facial symmetry, smile line, tooth display, midline relationship, tooth proportions, and other relevant aesthetic parameters. A digital intraoral scan was subsequently performed to obtain three-dimensional records of the maxillary dentition.

### Digital Smile Design and Virtual Mock-Up:

The digital records were imported into Exo-cad software for virtual designing of the proposed laminate veneers. The tooth morphology and dimensions were digitally modified according to the patient's facial characteristics, existing tooth anatomy, smile display, and aesthetic requirements. A virtual digital mock-up was created to establish the proposed tooth dimensions and contours. The digital design was subsequently used to fabricate a three-dimensional model using CAD/CAM technology. A putty index was fabricated from the digitally designed mock-up (Fig 2). This index was subsequently used to transfer the planned tooth morphology intraorally using a provisional bis-acryl resin material.

### Intraoral Mock-Up and Patient Preview:

The digitally planned mock-up was transferred intraorally using the putty index and provisional bis-acryl resin. The provisional restoration allowed the patients to visualize the proposed treatment outcome directly in the oral environment. The patients were actively involved in evaluating the proposed result. Any necessary modifications were made before definitive treatment. An important advantage of this workflow was that the patient could visualize the proposed aesthetic outcome before irreversible tooth preparation. After both the clinician and patients were satisfied with the proposed design, the treatment proceeded to the definitive phase.

### Tooth Preparation and Digital Transfer:

Tooth preparation was performed according to the finalized veneer design while attempting to preserve sound tooth structure and maximize the available enamel for adhesive bonding (Fig 3). Following preparation, the teeth were evaluated clinically. Digital intraoral scans of the prepared teeth and provisional restorations were obtained. The digital data were exported in STL format and transferred to the CAD/CAM workflow for fabrication of the definitive restorations.

### CAD/CAM Fabrication of Definitive Veneers:

The definitive restorations were digitally designed using the finalized approved morphology. Lithium disilicate laminate veneers were fabricated using the CAD/CAM workflow. The fabricated veneers were evaluated for morphology, marginal adaptation, proximal contacts, shade, contours, and overall aesthetic integration before definitive cementation.

### Try-In and Adhesive Cementation:

The provisional restorations were carefully removed, and the prepared tooth surfaces were cleaned thoroughly to eliminate any residual provisional material. The definitive veneers were tried intraorally. Shade confirmation of final resin cement and aesthetic evaluation were performed using a neutral-shade try-in paste (Fig 4). The veneers were assessed for shade,

translucency, morphology, proximal contacts, marginal adaptation, and overall harmony with the adjacent dentition. The internal surfaces of the lithium disilicate veneers were conditioned using the ceramic etching protocol employed for the restoration. The ceramic surfaces were etched using 9% hydrofluoric acid for the prescribed clinical duration, followed by thorough rinsing and drying. The etched ceramic surface demonstrated the characteristic frosted appearance. A silane coupling agent was subsequently applied to the treated ceramic surface and gently air dried. The prepared tooth surfaces were cleaned and etched with 37% phosphoric acid, followed by thorough rinsing and gentle air drying. A compatible bonding agent was applied and light cured according to the manufacturer's instructions (Fig 5). A light-cured resin cement in a neutral shade was applied to the internal surfaces of the veneers. Each veneer was carefully positioned and seated under controlled pressure. Excess resin cement was removed from the marginal and interproximal regions before polymerization. The veneers were light cured from multiple directions according to the recommended curing protocol (Fig 6). Following cementation, the restorations were evaluated for marginal adaptation, proximal contacts, occlusion, phonetics, and overall aesthetic appearance.

**Postoperative Instructions and Follow-Up:**
The patients received detailed postoperative instructions regarding oral hygiene maintenance, interdental cleaning, avoidance of excessive biting forces, and maintenance of the restorations. Patients are being followed up at regular intervals. After 12 months follow up, the clinical condition of the veneers, periodontal response, occlusion, aesthetic appearance, and patient satisfaction were assessed and documented (Fig 7).

**DISCUSSION:**
The primary objective of anterior aesthetic rehabilitation is to establish a harmonious relationship between the teeth, gingival tissues, lips, and facial structures while satisfying the patient's expectations. In the present cases, the patients presented with maxillary anterior midline diastema and expressed a specific desire for improvement in smile aesthetics. A digitally integrated laminate veneer workflow was therefore selected to facilitate both aesthetic planning and patient participation.

Traditional aesthetic rehabilitation frequently relies on diagnostic casts, conventional wax-ups, silicone indices, and direct chairside mock-ups. Although these approaches remain clinically useful, digital technologies provide additional opportunities for data acquisition, virtual planning, three-dimensional visualization, and CAD/CAM fabrication. Digital workflows can facilitate communication between the clinician, laboratory, and patient and allow the proposed restorative morphology to be evaluated before definitive treatment.[7]

One of the important features of the present cases was the use of a digital mock-up followed by an intraoral provisional mock-up. A digital simulation provides a visual representation of the anticipated treatment, but patients may not always be able to translate a two-dimensional image or virtual simulation into the expected three-dimensional intraoral result. The intraoral mock-up addresses this limitation by providing a direct representation of the proposed tooth form. Garcia et al. reported that combining digital smile design with a mock-up can enhance communication and contribute to more predictable aesthetic treatment planning.[8]

Another important consideration is the selection of restorative material. Lithium disilicate was selected in the present cases because of its favourable combination of aesthetics, translucency, strength, and suitability for adhesive bonding. Contemporary evidence indicates that lithium disilicate laminate veneers demonstrate satisfactory clinical performance. A recent systematic review and meta-analysis reported a pooled long-term survival rate of approximately 96.8% for lithium disilicate laminate veneers at a mean observation period of 10.4 years, although the authors emphasized the need for further high-quality clinical evidence.[3]

The preservation of enamel is another important consideration in veneer treatment. Adhesive bonding to enamel is generally more predictable than bonding to dentin, and increased dentin exposure has been associated with reduced clinical success.[5,6] Therefore, treatment planning should emphasize conservative tooth preparation and preservation of sound enamel whenever clinically possible. In the present cases, the preparation was guided by the approved digital design with the objective of maintaining a conservative approach.

The adhesive protocol represents a critical component of ceramic veneer treatment. Lithium disilicate is a silica-based glass ceramic and can be conditioned using hydrofluoric acid followed by silane application to facilitate micromechanical and chemical interaction with resin cement. Contemporary literature supports hydrofluoric acid etching followed by silane application as an important component of the bonding protocol for glass-ceramic laminate veneers.[6] The tooth surface was subsequently conditioned with phosphoric acid and an adhesive system before placement using light-cured resin cement.
The use of a light-cured resin cement is advantageous for thin anterior ceramic restorations because of its favourable aesthetic characteristics and extended working time. Shade selection using a try-in paste before definitive cementation is particularly important because the final appearance of thin ceramic veneers is influenced by the interaction between the ceramic, cement, and underlying tooth substrate.

The two cases also demonstrate the versatility of the workflow in patients with different expectations. The first patient presented with both diastema and anterior attrition, whereas the second patient primarily sought rapid correction of spacing. In both cases, digital planning provided a mechanism for establishing the proposed restorative morphology and communicating the treatment outcome.

**LIMITATIONS:**
Despite these advantages, digital workflows have certain limitations. The accuracy of the final result remains dependent on the quality of digital data acquisition, software design, tooth preparation, manufacturing accuracy, ceramic processing, adhesive procedures, and clinical execution. Digital visualization should not be considered a substitute for comprehensive clinical examination and diagnosis. In addition, the aesthetic result of the final restoration may differ from the virtual simulation because of factors such as ceramic thickness, substrate shade, cement shade, lighting conditions, and individual optical properties.

**CONCLUSION:**
The digitally integrated workflow provided a predictable and patient-centered approach for anterior aesthetic rehabilitation using lithium disilicate laminate veneers. The combination of digital intraoral scanning, Exo cad-based virtual designing, CAD/CAM model fabrication, intraoral mock-up, and CAD/CAM-fabricated lithium disilicate laminate veneers represents a conservative and efficient approach for appropriately selected cases of anterior spacing and aesthetic disharmony. However, successful long-term outcomes remain dependent on appropriate case selection, conservative preparation, preservation of enamel, accurate ceramic fabrication, meticulous adhesive cementation, occlusal control, and regular maintenance. Larger clinical studies with longer follow-up are required to establish the long-term clinical effectiveness of this complete digital workflow.

**PATIENT CONSENT:**
Written informed consent was obtained from the patients for the proposed treatment. Additional consent was obtained for the use of clinical photographs and other relevant records for scientific publication, while maintaining patient confidentiality.

**ETHICAL CONSIDERATIONS:**
The treatment was performed in accordance with the ethical principles applicable to clinical care and institutional requirements.

**FUNDING:**
No external funding was received for the present case series.

**CONFLICT OF INTEREST:**
The authors declare that there is no conflict of interest related to this manuscript.

**IMAGES:**

**Fig 1: High resolution photographs as per digital designing protocol.**

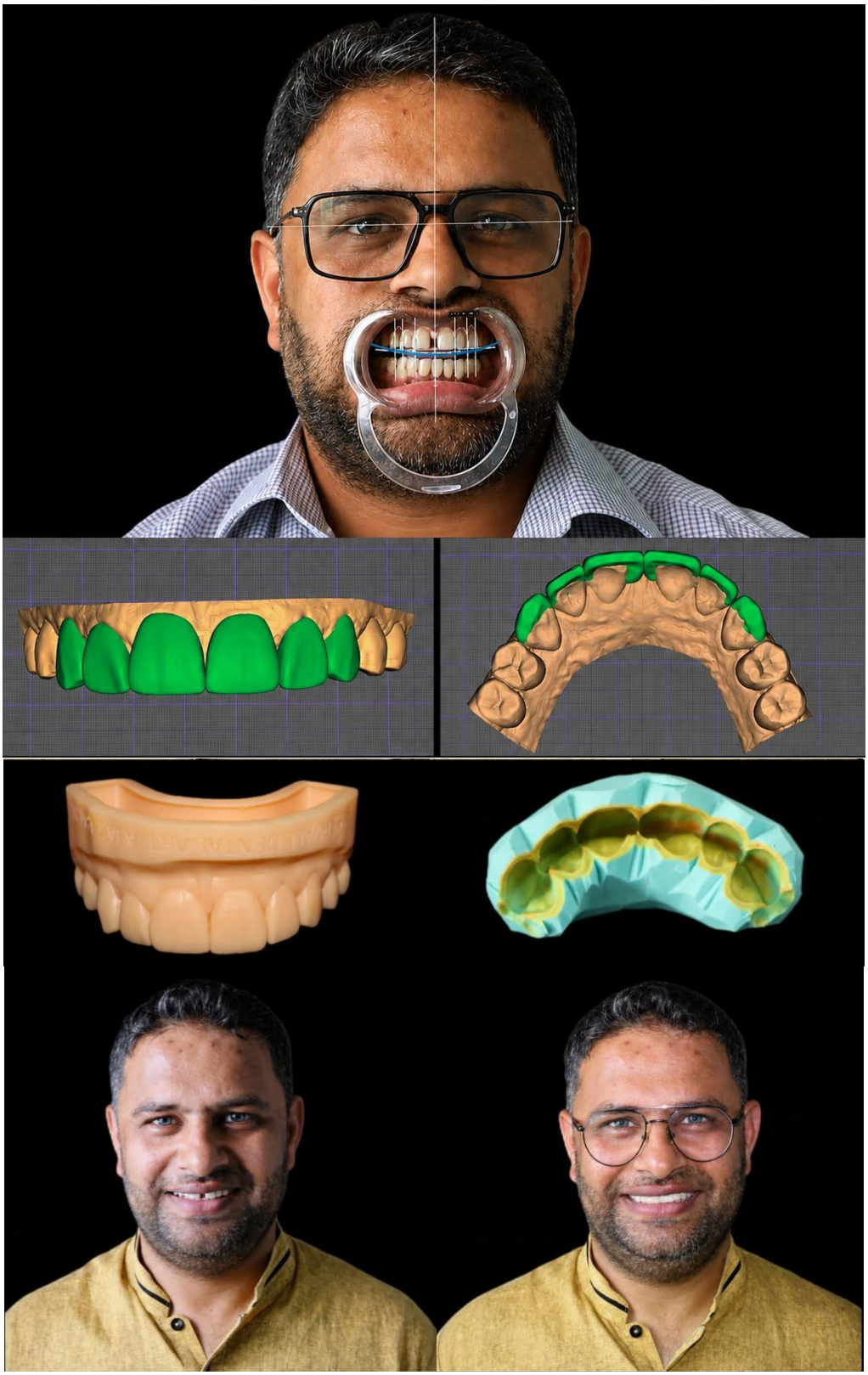

**Fig 2: Designing of prosthesis digitally using Exo cad software, Digital mock up, temporization of prosthesis before tooth preparation.**

**Fig 3: Pretreatment photograph, Tooth preparation for laminate veneers.**


**Fig 4: Digitally made E max lithium disilicate laminate veneers, checking of shade using try in paste before final bonding.**


**Fig 5: Etching of laminates with 9% hydrofluoric acid, Frosted appearance, Application of silane coupling agent, Etching of prepared tooth, Application of bonding agent, Light curing after bonding agent.**

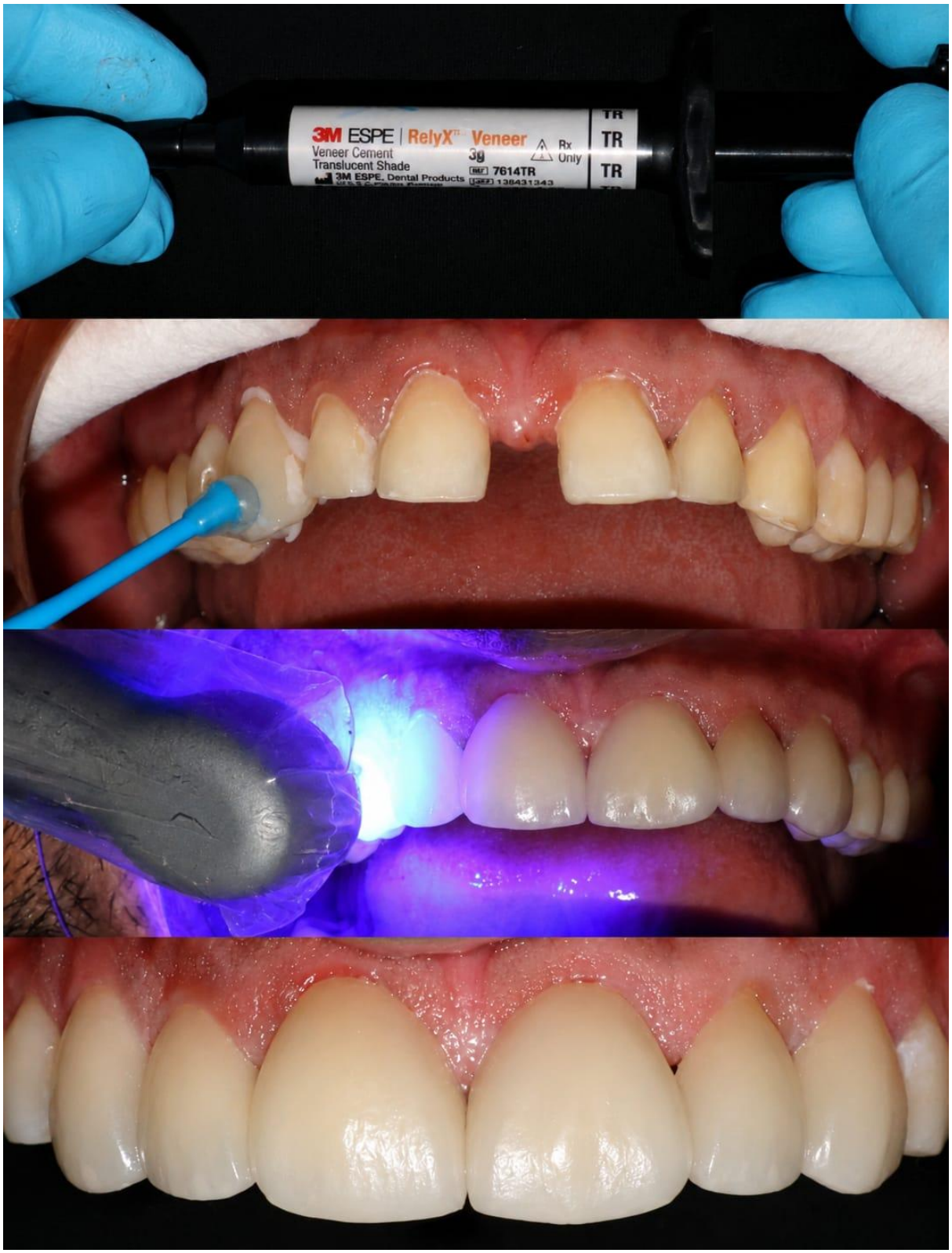


**Fig 6: Luting of laminate veneers using veneer resin cement of neutral shade, Light curing, Laminate veneers in place.**

**Fig 7: Post treatment outcome in Case 1.**

**Fig 8: Post treatment outcome in Case 2.**

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