Esthetic treatment of anterior spacings in a patient with localized microdontia using no-prep veneers combined with periodontal surgery: A clinical report

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Objectives: This case report describes the treatment of a patient with maxillary anterior spacings, resulting from microdontia, using a multidisciplinary approach to improve her esthetic appearance.

Materials and Methods: A 23-year-old Thai female patient had multiple spaces between her maxillary anterior teeth with a high smile line and an unsymmetrical gingival level. The Recurring Esthetic Dental (RED) proportion was used to determine the widths of maxillary teeth and Bolton’s analysis was used to confirm the RED results, after that a diagnostic wax-up model was fabricated. Esthetic crown lengthening was performed from the right maxillary canine to the left maxillary canine to reduce excess gingival exposure and increase the length of the teeth according to the proportion acquired from the calculation. After complete gingival healing, no-prep ceramic veneers were placed on the maxillary anterior teeth using the IPS Empress® Esthetic ceramic system.

Results: The no-prep veneers preserved all tooth structures and gave a satisfactory esthetic result. The patient was satisfied with the outcome. The final restorations closed the spaces with the natural appearance the patient desired. The function and occlusion of the restorations were good. The veneers and the periodontal tissues were in good condition at the 1-year recall.

Conclusion: The multidisciplinary approach and no-prep ceramic veneers used in this case restored the maxillary anterior spacing and provided an excellent esthetic outcome. However, successful treatment in the anterior esthetic zone requires a thorough diagnosis and meticulous step-by-step treatment planning.

Keywords: ceramic veneer, maxillary anterior spacing, microdontia, no-prep veneer


Introduction

People have become increasingly concerned about esthetics. Therefore, a perfect smile can give patients more confidence and feel comfortable in social situations. Esthetic dental treatment plays an important role in improving a personal appearance through a great smile that also has good clinical function. Thus, esthetic dental treatment is a combination of art and science. To obtain the desired clinical outcome, both dental practitioners and laboratory technicians must carefully consider the available treatment options that provide long-term success and outstanding esthetic results. [1]

Anterior teeth spacing is a type of malocclusion whose effect is mostly esthetic. Microdontia is a condition in which the teeth are smaller than average due to the underdeveloped permanent teeth and typically creates gaps in the dental arch. Abnormal tooth morphology, including tooth shape and size, result from genetics, specific syndromes,
environmental factors, trauma, medication use, and radiation patients receive while their teeth are developing. [2-4] Previous studies found that 5.7–7.98% of females were affected by microdontia and hypodontia, which was higher than that of males (3.1–5.8%) [5-8].

Selecting the appropriate treatment modalities for anterior teeth spacing caused by microdontia requires the expertise of the dentists and a multidisciplinary approach. Orthodontic treatment alone cannot completely close these spaces while maintaining the correct occlusion and a satisfactory esthetic result. According to Fekonja et al., 37.9% of subjects who were affected by dental anomalies require treatment by dental specialists, including restorative dentists, periodontists, prosthodontists, oral and maxillofacial surgeon. They also found that 92.4% of the patients were satisfied with the treatment outcome. [9] Treatment options for microdont teeth are based on the patient’s complaints and expectations and range from orthodontic treatment, restorative treatment, extraction followed by tooth replacement, or no treatment. [10] To close the spaces, direct composite restorations are the most conservative approach because this method can be performed without removing tooth structure. [11] Another minimally invasive option is traditional porcelain laminate veneers (PLVs). This is an indirect restorative technique that requires minimal enamel reduction and gives a superior esthetic appearance, higher abrasive resistance, and good color stability. However, the mean enamel thickness at the cervical area of the central and lateral incisors are 345µm and 235µm respectively. Thus, a 0.5 mm chamfer preparation creates a dentin exposure at the porcelain veneer margins. [12] Long-term studies reported that the survival rate of porcelain veneers was 97.5%. [13, 14] In addition, veneers with their preparation margin in enamel are more likely to have a long-term success compared with those bonded to dentin. [15]

In 1955, acid etching of the enamel surface was introduced by Buonocore. [16] Subsequently, Bowen developed the first bonding system. [17, 18] Due to improvements in ceramic materials and bonding procedures, patients can now receive bonded restorations that do not require preparing sound tooth structure. This allows dentists to fabricate ceramic restorations that are very thin (0.3 mm thick). [19-21] Thus, no-prep veneers can be either partial or complete facial coverage veneers.

This clinical case report describes the sequence of conservative treatment procedures performed on a female patient at the Esthetic Restorative and Implant Dentistry clinic at the Faculty of Dentistry, Chulalongkorn University. The patient was chosen because of her dental anomalies; microdontia that caused multiple spaces in the anterior maxillary region, and an excessive gingival display. Her treatment included esthetic crown lengthening and no-prep veneers that comprised a combination of partial and ultrathin ceramic veneers.

**Clinical report**

A 23-year-old Thai female presented at the Esthetic Restorative and Implant Dentistry Clinic, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand with a chief complaint of multiple spaces between her upper anterior teeth which caused by microdontia (Figure 1). Her major concern was an unesthetic appearance and she desired to close these gaps in a manner that resulted in a natural look. The patient had never undergone orthodontic treatment and was satisfied with her tooth color. A brief evaluation of her medical history indicated no immediate concerns.

The treatment began with a clinical examination, and a series of pre-operative intra- and extra-oral photographs were taken. These photographs were used to determine the facial profile, smile line, gingiva zeniths, occlusal planes, tooth color, and shape. A preliminary impression
was taken with alginate to fabricate diagnostic casts, followed by a facebow transfer and bite registration. Her intra-oral examination revealed generalized spacing and abnormal tooth shape and size of the upper anterior teeth from the right maxillary canine to the left maxillary canine (Figure 2), and mild gingival inflammation due to dental plaque-induced gingivitis. A thick gingival biotype and high frenum attachment were observed. Radiographic evaluation revealed a healthy periodontium and a normal pulp and periapical condition. (Figure 3). The occlusal relationship classification was class I molar and class I canine.

The overjet and overbite were 2 mm. The dental midline was deviated 1 mm to the right compared with the facial midline. The facial analysis revealed that her interpupillary line and commissural line were parallel to a horizontal line. The patient had a normal profile (skeletal class I).

The smile analysis indicated that the patient had a high lip line with excessive gingival exposure and an asymmetrical gingival level between the left and right sides of the upper dental arch at full smile. The curvatures of the upper anterior teeth and the lower lip line were harmonious (Figure 4). The evaluation of the inclination and arrangement of the patient’s maxillary anterior teeth revealed that the maxillary lateral incisors had a slight distal flare. The examination of the tooth color and characteristics found that the maxillary central and lateral incisors had a light yellowish color, pronounced macro- and micro-texture on the tooth surfaces, and a halo effect at the incisal edges. In contrast, the canines had a darker shade.
**Treatment plan**

The following treatment plan was accepted by the patient:

1. Full mouth prophylaxis, scaling, and direct resin composite restorations on the posterior teeth to correct old defective restorations.
2. Periodontal surgery; frenectomy, and teeth 13 to 23 esthetic crown lengthening to increase the teeth length and provide the right proportion of the maxillary anterior teeth with a 3-month healing period.
3. Non-prep ceramic veneers; teeth 13 to 23 partial and ultrathin ceramic veneers to restore the upper anterior tooth spacing.

Before the execution of the treatment plan, the Recurring Esthetic Dental (RED) proportion [22] and Bolton’s analysis [23] were used to determine the correct dental proportions and create a diagnostic wax-up. Ward described the RED proportion as the proportion of the successive width of the teeth remaining constant as viewed from the front when progressing distally from the midline. [24] The 70% RED proportion has been recommended for normal length teeth with a 78% width/height ratio of the maxillary central incisors. [25, 26] After calculating the esthetic proportions of the upper anterior teeth, Bolton’s analysis needs to be done to confirm that the restorative dentist can increase tooth width without tooth size discrepancy. In 1958, Bolton calculated that when the occlusion is perfect, there is a constant proportion between the upper and lower dentition. Class I occlusion will be possible only when the mesio-distal dimension of the lower anterior teeth is 77.2% of the mesio-distal dimension of the upper anterior teeth. [23] The results of the RED/Bolton’s analysis then need to be transferred to a diagnostic wax-up. The diagnostic wax-up should be performed using wax with a different color from the diagnostic cast, preferably without any dental reduction on the cast. The diagnostic wax-up allows visualizing the areas that will be covered by the ceramic restorations and determining the gingival margins. Using the wax-up allows the restorative dentist to communicate with the dental technician and the patient (Figure 5A).

**Treatment procedures**

**Direct Resin Composites**

The defective restorations on molars were replaced using a resin composite. After local anesthesia and rubber dam application, the old restorations in teeth 16, 17, 26, 27, 36, 46, and 47 were removed. The tooth cavities were etched for 15 sec with 37.5% phosphoric acid gel (Kerr Gel Etchant; Kerr, Orange, CA, USA), rinsed thoroughly, and air dried leaving moist dentin surfaces. Primer and bonding agents (OptiBond FL; Kerr, Orange, CA, USA) were applied following manufacturers’ instructions and then light-cured for 20 sec. A nanofilled resin composite material A3.5 shade (Premise; Kerr, Orange, CA, USA) was placed in the tooth cavity using an incremental technique (2-mm thick layers) and light cured for 40 sec. The resin composite was then shaped, finished, and polished (Figure 6).

**Periodontal Surgery**

**Esthetic crown lengthening**

Prior to esthetic crown lengthening, a wax-up model of the six anterior teeth was created to determine the required gingival reduction on each tooth. The information from the wax-up model was transferred to the patient’s mouth using a silicone jig of the waxed diagnostic cast. The mock-up was made from a temporary material, A2 shade (LuxaTemp®; DMG America, Englewood, NJ, USA) to evaluate the proper gingival level and allow the patient to approve the proposed treatment plan (Figure 5B). An impression of the mock-up was taken. A clear acrylic periodontal stent was fabricated from the stone model of the final intraoral correction cast. Esthetic crown lengthening was performed on teeth 13 to 23 under local anesthesia. An oral antibiotic (1,000 mg) was administrated 1 h before surgery and antiseptic mouthwash 0.12% chlorhexidine gluconate was used. The surgical stent was inserted and then the gingivectomy outline was marked. After removing the gingival tissue, a labial full-thickness mucoperiosteal flap was reflected, and osteotomies were performed to provide a 3 mm clearance between the final
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restoration margin and the alveolar crest to maintain the biologic width. [27] The flap was repositioned and sutured in place using interrupted sutures with 4-0 Vicryl (Ethicon/Johnson & Johnson, Somerville, NJ, USA). The sutures were removed 7 d after surgery, followed by a healing period of 3 months (Figure 7).

Frenectomy

Due to the patient’s high labial frenum attachment, a frenectomy was performed under local anesthesia. The frenum was held with a small curved hemostat and the upper and lower aspect of the frenum was cut through with a 15c blade. Interrupted sutures using absorbable Vicryl 5-0 sutures (Ethicon/Johnson & Johnson, Somerville, NJ, USA) were placed along the lateral margins of the wound in a linear direction after the mucosa of the wound margins was undermined using scissors (Figure 7).

Ceramic Veneers for the Anterior Maxillary Teeth

Based on the path of insertion of the no-prep veneers, tooth preparation was not required on this patient. Teeth 11 and 21 were planned for partial veneers, and the rest of the upper six anterior teeth were assigned no-prep veneers. Before the final impression, the teeth were polished with pumice and shade selection was performed visually using a Vita 3D-Master Shade Guide (Vita Zahnfabric, Bad Säckingen, Germany). For the correct shade matching of value, chroma, and hue, dental photographs were taken with a shade tab similar to the tooth shade. A close-up picture with a black background can also be taken to evaluate details such as mamelons, translucency, opalescence, incisal halo, and tooth surface characteristics. The gingival sulcus of the six anterior maxillary teeth was gently packed with retraction cord #000 (Ultrapak®, Ultradent Products Inc., Salt Lake City, UT, USA) to obtain adequate gingival displacement. A full-arch impression was taken with polyvinylsiloxane (Flexitime®, Heraeus Kulzer South Bend, IN, USA) using a double-mixed single-impression technique and submitted to the laboratory (Dental Art Lab, Bangkok, Thailand). A bite registration was performed using a fast-set silicone (Blu-Mousse®; Parkell Inc., Edgewood, NY, USA). The working model was used to prepare the wax-up of the final tooth shapes that were proportionally correct (Figure 8). The no-prep ultrathin and partial veneers were fabricated from a low translucent heat-pressed ceramic ingot shade.
A1 (IPS e.max® Press, Ivoclar Vivadent, Schaan, Liechtenstein) with a layering technique to mimic natural tooth characteristics (Figure 9, 10).

The fabricated veneers were inspected on the original stone dies for their seating, proximal contacts, marginal adaptation, and path of insertion (Figure 11).

Clinically, the veneers were tried in until they were well-seated on each tooth and the color of the ceramic veneers were evaluated on the teeth using a water-soluble try-in gel (NX3 Try-In Gel; Kerr, USA) (Figure 12). Prior to cementation, the restorations and teeth were prepared for bonding according to the manufacturers’ instructions. The inner surfaces of the ceramic veneers were treated with 9% hydrofluoric acid (Porcelain Etch®, Ultradent Products Inc., South Jordan, UT, USA) for 20 sec, washed thoroughly with air-water spray, and then air-dried. A silane coupling agent (Monobond-S®, Ivoclar Vivadent, Schaan, Liechtenstein) was applied to the internal ceramic surfaces and gently air-blown with hot air for 1 min. A coat of adhesive (Heliobond®, Ivoclar Vivadent, Schaan, Liechtenstein) was then applied to the inner surface of the restoration and left uncured. The enamel surfaces of the teeth were cleaned with pumice, washed with water, air-dried, and etched with 37.5% phosphoric acid (Kerr Gel Etchant, Kerr, Orange, CA, USA). An alcohol-based adhesive system (Optibond Solo Plus®; Kerr, Orange, CA, USA) was thinly applied on the tooth surface, air dried, and light cured for 10 sec. A thin layer of light-cured resin cement (NX3 Nexus, Kerr, Orange, CA, USA)

Figure 8 The wax-up of the no-prep veneers on the working model; the mesial and distal aspects of tooth #11 and #21 were partial veneers and tooth #13, #12, #22, and #23 were ultrathin veneers.

Figure 9 The no-prep veneers were fabricated from heat-pressed ceramic ingots (IPS e.max® Press, Ivoclar Vivadent, Schaan, Liechtenstein) and a halo effect was created with a nano-fluoroapatite layering ceramic.

Figure 10 The minimum thickness 0.3-0.5 mm that no-prep veneers could be fabricated.

Figure 11 The fabricated veneers were examined for marginal adaptation on the working models.

Figure 12 Clinically, the veneers were tried in until they were well-seated on each tooth and the color of the ceramic veneers were evaluated.
was loaded on the internal surface of the ceramic veneer. The restorations were slowly seated on the teeth and the pressure was applied to allow the luting cement to adapt to the tooth surface. While holding the veneers in place, excess resin cement was carefully removed using a sponge and a fine-tipped brush, and then light cured by an LED light-curing tip (DEMI PLUS, Kerr, WI, USA) for 40 sec on both labial and palatal surfaces. The sequence of cementation depended on the path of insertion. During cementation, it was difficult to position a small piece of the partial ceramic veneers. Therefore, the full veneers on tooth 12 and 22 were cemented prior to the partial veneers on tooth 11 and 21 to provide proximal contact for the partial veneers while cementation.

After cementation, an occlusal adjustment was done and the remaining cement excess was removed. The interface between the enamel surface and partial veneers was blended with resin composite (A1 shade, Premise; Kerr, Orange, CA, USA), finished, and polished. The patient was satisfied with the result (Figure 13). Radiographs were taken to ensure that there were no overhanging restorations (Figure 14). The patient was given instructions for proper home care and maintenance of the ceramic veneers.

The follow-up evaluations at 1 month, 6 months, and 1 year after cementation showed a pleasing result and the patient was very satisfied with her smile (Figure 15).

Discussion

The key to a successful treatment outcome is a correct diagnosis and an appropriate treatment plan. The etiology and contributing factors for maxillary anterior spacing such as genetics, caries, periodontal disease, tongue thrusting, and high frenum attachment should be carefully considered before determining the final restoration type. In the present case, the patient had microdontia, which is a condition that results from underdeveloped permanent teeth. [28, 29] Microdontia tends to be hereditary and often causes multiple spaces in the dental arch that result in an altered occlusal pattern. [29, 30] A patient’s chief complaint is always esthetics when their teeth are smaller in size or shape compared with the adjacent teeth, or have gaps between the teeth. However, in this situation, orthodontic treatment cannot completely close these spaces while maintaining the correct occlusion and good esthetic appearance. In the present case, a comprehensive treatment plan involving a multidisciplinary approach including operative, periodontics, restorative, and surgery was required. The diagnostic wax-up was a significant tool, which can help to communicate with the patient and the dental technician. Before the final restorations, the RED proportion was calculated and transferred to a wax-up model to provide the actual width and length of each tooth.
An excessive gingival display can be caused by maxillary overgrowth, short upper lip, or reduced eruption of the maxillary anterior teeth. Different treatments are required depending on the individual diagnosis. In the present case, a gummy smile resulted from limited passive eruption, which can be corrected by crown lengthening surgery, gingivectomy, or an apically positioned flap with or without osteotomy based on the distance between the alveolar bone crest to the cementoenamel junction. [27]

There is a wide range of treatments that can be used to restore anterior spacing. The most drastic is a full contour-crown, which results in the greatest loss of tooth structure. However, there are numerous more conservative treatment options available as direct and indirect restorations for anterior teeth. Direct resin composite restoration is a conservative approach and less expensive compared with other indirect restorations. [31] However, its short-term color stability and its low resistance to wear are disadvantages of this material. In contrast, porcelain veneers offer excellent longevity and appearance. Beier et al. found that porcelain laminate veneers offer a predictable and successful outcome with an estimated survival rate of 93.5% over 10 years. [32]

Currently, it is unacceptable to sacrifice sound enamel to create a space for an artificial restorative material. Bonding techniques combined with novel laboratory techniques have markedly improved to allow the maximum preservation of dental tissues. Previously, PLVs were first used in a “no-prep” manner using feldspathic porcelain. [33] As PLVs gradually evolved, minimally invasive preparation resulted in increased esthetics by masking tooth discoloration and improved gingival tissue responses. [34] Moreover, ceramic veneers cemented on dental preparations restricted to the enamel have a high survival rate. [35] Thus, a no-prep ceramic veneer is indicated in situations that allow a material to be added to the tooth structure, including an ideal occlusion and proper tooth position. To avoid overcontouring the restorations and tooth size discrepancies, the patient’s occlusion should be examined and the tooth size discrepancy calculated using Bolton’s analysis to confirm the proposed tooth proportion that was obtained from the RED proportion. [26] In the present case, the patient had a class I canine and class I molar classification. The width of each upper anterior tooth from the diagnostic wax-up was calculated and had the correct dimension in accordance with the Anterior Bolton’s discrepancy analysis. [23]

The contraindications for no-prep ceramic veneers are improper tooth alignment and masking darkened tooth structure. An incorrect tooth axis and angulation may lead to an overcontoured restoration and injure the gingival tissue. No-prep veneers cannot mask discolored teeth due to the thinness of the restorations. However, the main advantage of using veneers without preparation is the preservation of enamel. The enamel surface is suitable for bonding with resin due to its highly mineralized structure and low moisture content compared with dentin. Ceramic veneers bonded to enamel demonstrated high survival rates, which decreased when bonded to dentin. [36, 37] In a retrospective survey of up to 12 years, Gurel et al. founded a survival rate of 99% for veneers with preparations within enamel and 94% for veneers with enamel only at the margins. [15]

To mimic the natural tooth color of the nonprepared teeth in the present case, IPS e.max Press was chosen. In 2005, IPS e.max Press (Ivoclar Vivadent, Schaan, Liechtenstein) was introduced as a new material to replace IPS Empress II. This material consists of lithium disilicate with a high crystalline content in a glass matrix. The chemical basis of the material is the same as the chemical basis of IPS Empress II, however, its physical properties and translucency are improved due to its different firing process. [38] The IPS e.max materials are available in several degrees of translucency and have a high flexural strength of up to 360–400 MPa. Thus, this material can give a smooth and harmonious color
with the existing shade of the abutment tooth. A retrospective study on the clinical outcomes of IPS e.max Press restorations demonstrated a 97.2% survival rate and 1.7% failure rate for ceramic veneers after function for up to 5 years. The failures mainly occurred in the first 3 months after cementation and the main reasons were ceramic chipping and fracture. [39] However, the major challenges of the present case were the ceramic-tooth transition zone and the handling technique of the partial coverage no-prep veneers. The partial veneer restorations had to be carefully transferred from the master cast to the patient’s mouth in the correct position. The irregularities of the restoration margins and direct resin composite can be used to blend the color and smooth the surface at the transition area.

Friedman reported that 93% of porcelain veneers are successful over a period of 15 years; the 7% that failed resulted from fracture (67%), microleakage (22%), and de-bonding (11%) of the veneer. [40] Factors that affect the bond strength of ceramic veneers are the adhesive technique and placement technique, including etching the porcelain and enamel, silane coupler, bonding resin, luting agent, and veneer fit. Fradeani et al. suggested that porcelain laminate veneers must be bonded using the correct adhesive technique to reach a high survival rate. [41] Moreover, patient’s habits and compliance are also important factors that have to be considered to maintain the porcelain laminate veneer restorations in a good condition for a long period of time.

**Conclusion**

This clinical report presented the treatment of multiple spaces in the anterior maxillary region in the patient with microdontia. No-prep ceramic veneers are the primary choice for anterior esthetic rehabilitation for a patient who has an ideal occlusion and proper tooth position. It is important to properly select the cases, plan, execute, and deliver the restorations. A comprehensive treatment plan involving a multidisciplinary approach was required. The diagnostic wax-up is a significant tool for analyzing the proposed treatment plan and communicating with the dental team and the patient.

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