

# Multidisciplinary treatment of a median diastema in a patient with tongue-tie and tongue thrusting : a clinical report

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**Objective:** This case report describes the treatment of a female patient with a median diastema, caused by tongue-tie and a tongue thrusting habit, using a sequence of multidisciplinary treatments to achieve an esthetic outcome.

**Materials and procedures:** A treatment plan was developed to first perform a frenectomy at the lower lingual frenum to correct the tongue-tie and utilize a removable orthodontic appliance with tongue cribs to train the patient's swallowing habit. An asymmetrical gingival line was visible when the patient smiled. To evaluate the desired gingival level and the proportions of the restorations to be made based on the recurring esthetic dental (RED) proportion, a diagnostic wax-up model was fabricated. Esthetic crown lengthening was performed to correct the gingival line. Home whitening was prescribed for 2 weeks, with an additional 2-week waiting period to ensure tooth color stability. Final restoration was obtained by placing ceramic veneers on the maxillary anterior teeth.

**Conclusions:** This multidisciplinary treatment approach achieved excellent esthetic results; after veneer cementation, the patient exhibited greater confidence with her new smile.

**Keywords:** multidisciplinary approach, diastema, tongue-tie, tongue thrusting, frenectomy, removable appliance, esthetic crown lengthening, ceramic veneer

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## Introduction

Maxillary midline diastema (MMD) is a common esthetic complaint of patients and a relatively common dental malocclusion characterized by a space between the maxillary central incisors, with functional and esthetic consequences. Gass and colleagues [1] reviewed the literature and reported that the prevalence of MMD ranged from 1.6–25.4% in adults in various populations and age groups. These authors also reported that MMDs are more common among African-Americans compared with Caucasians, Asians, or Hispanics [1]. MMD can adversely affect body image and self-esteem, and it can be one of the most negative factors in self-perceived

dental appearance [2]. Kerosuo and colleagues [3] conducted a study involving European adults found that patients with a midline diastema were perceived as being less socially successful and of lower intelligence. In addition to poor esthetics, patients who request closure of a MMD also commonly complain of impaired speech, lip biting, and adverse psychological effects.<sup>3</sup> Before formulating a definitive treatment plan for a patient with a MMD, the clinician needs to understand the etiology of the condition. MMD may be due to an anomaly in tooth number (such as a mesiodens or hypodontia) or tooth size (such as microdontia), an enlarged labial frenum, abnormal oral habits (such as tongue thrusting or finger nail biting), or advanced periodontitis [4-6].

Tongue-tie or ankyloglossia is a congenital condition characterized by a short lingual frenum. The prevalence of tongue tie is reported to be 4.2 to 10.7% in various populations [7]. There is a mild male predilection for ankyloglossia with a ratio 1.5:1 [8]. The exact cause of ankyloglossia is unknown, although it is likely to be due to abnormal development of the mucosa covering the anterior two-thirds of mobile tongue [9]. An abnormal frenal attachment may affect the movement of muscular structures such as the lips, tongue, and cheeks, which may affect the position of the jaws and arrangement of the dentition. Due to its restricted mobility, the tongue cannot be lifted upward and may subsequently lead to a tongue thrusting habit and an open bite [10].

Tongue thrusting habit is a condition in which the tongue makes contact with any teeth anterior to the molars during swallowing [11]. Most frequent signs of tongue thrusting are said to be forward tongue posture and tongue thrusting during swallowing, contraction of the perioral muscles (hyperactive mentalis and orbicularis oris), excessive buccinator hyperactivity, and swallowing without the momentary tooth contact normally required [12]. The effect of tongue thrusting on dentofacial development depends on several factors: the frequency of swallowing or how often the tongue exerts force on the teeth, the severity of the force exerted on the teeth, the counteraction of these factors by other muscular structures such as the lips, the resistance of dentoalveolar structures to displacement, and the resting position of the tongue when no swallowing is occurring [13]. Using a standard procedure, tongue thrust assessment can be simply performed by practitioners. Considering the relationship between deviated swallowing and dentofacial morphology, it is suggested that dentists evaluate patients of all ages for evidence of tongue thrust swallowing.

When closing a diastema is desired, different treatment modalities include restoration,

orthodontics, prosthodontics, surgery, and various combinations of the above [5]. Determining the etiological factors contributing to the spacing problem and reversing these factors through therapy are the first steps in successful treatment. A comprehensive history, a thorough clinical examination, and clear radiographs are the foundation of a sound treatment plan. Successful treatment of a diastema is measured not only by space closure, but also by its long-term stability. Frequently, stability may require fixed stabilization and/or prosthetic intervention.

This clinical case report describes the sequence of procedures performed at the Esthetic Restorative and Implant Dentistry clinic, Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand, in the multidisciplinary treatment of a female patient. The patient was chosen for a case report because her tongue-tie and tongue thrusting caused the development of a median diastema, and she had excessive gingiva displayed in her smile. Her treatment consisted of a frenectomy at the lower lingual frenum, elimination of her tongue thrusting habit utilizing a removable orthodontic appliance, esthetic crown lengthening, home whitening, and ceramic veneers.

## Clinical Report

Our patient was a 30-year-old Thai female, who visited the Esthetic Restorative and Implant Dentistry Clinic at the Faculty of Dentistry, Chulalongkorn University, Bangkok, Thailand, with a chief complaint of broken composite veneers on teeth 11 (upper right central incisor) and 12 (upper right lateral incisor), a space between her maxillary incisors, and yellowish teeth. The patient had received composite veneers on teeth 11 and 12 for ten years ago. The patient had never undergone orthodontic treatment. The medical history of the patient was unremarkable.

An intraoral examination revealed a 1-mm space between teeth 11 and 21 (upper left central incisor). The patient presented with two broken composite veneers on the mesio-incisal surfaces of teeth 11 and 12. Her dental midline (mesial of tooth 11) coincided with the facial midline. Her overbite and overjet was 3 mm and 2 mm, respectively. The molar occlusal relationship was class III. Her gingival margin showed an asymmetrical gingival level, the gingival margin of tooth 21 was higher than that of tooth 11 and the gingival margin of tooth 22 (upper left lateral incisor) was higher than that of tooth 12 (Figure 1). The patient had tongue-tie (Figure 2) and a tongue thrusting habit (Figure 3). Oral hygiene was satisfactory. Radiographic

examination showed no periapical lesions of the maxillary anterior teeth (Figure 4).

A smile analysis was performed. An excessive gingival display was observed at teeth 13 (upper right canine), 12, 22, and 23 (upper left canine) when the patient fully smiled. The patient possessed a high lip line [16]. Her maxillary incisal curvature showed a convex curvature of the incisal edges that harmonized with the lower lip line when smiling. The patient had an asymmetrical gingival level between the right and left sides of the upper dental arch. Examination of the maxillary dental shade and contour showed that the color of her maxillary anterior teeth was light yellowish and displayed a grayish translucent line at the incisal edges. In contrast, the composite veneers on teeth 11, 12 and the canines were darker compared with the other teeth (Figure 5).



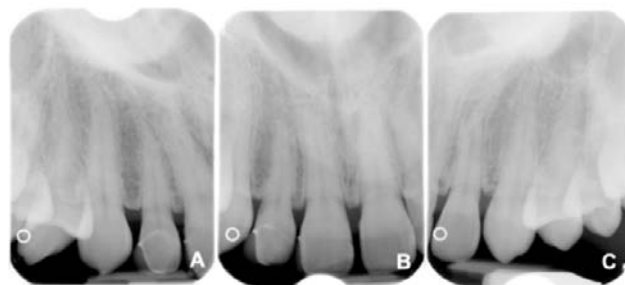
**Figure 1** Pre-operative photos of the maxillary teeth; occlusal (A), right (B), frontal (C), left (D), and occlusal of the mandibular teeth (E). Frontal view (C) showing maxillary median diastema.



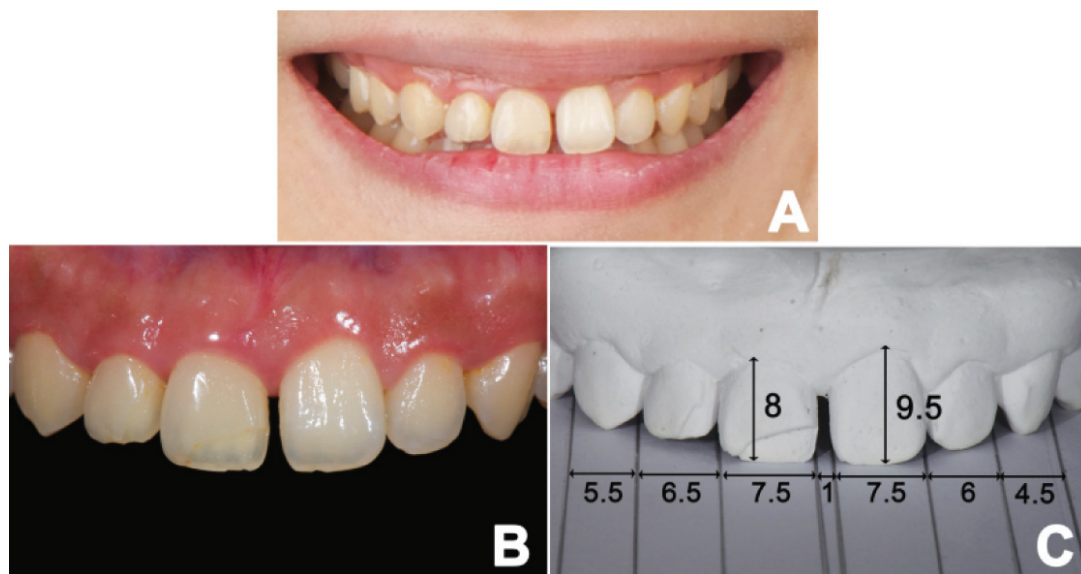
**Figure 3** The patient presented with tongue thrusting habit.



**Figure 2** The patient presented with tongue-tie (A). The patient attempting to raise the tongue to touch the palate (B).



**Figure 4** Periapical radiographs demonstrating no periapical lesions of the maxillary anterior teeth (A, B, and C).



**Figure 5** The patient's smile with an asymmetrical gingival level (A). The patient's six anterior maxillary teeth and characteristics of the central incisors before tooth preparation (B). Analysis of the study cast indicating the width of each tooth (C).

## TREATMENT PLAN

The patient agreed to the following treatment plan:

1. Direct resin composite restorations to repair the broken composite veneers on teeth 11 and 12.
2. Lower lingual frenectomy to correct the tongue-tie.
3. Myofunctional exercise and a removable orthodontic appliance with tongue cribs and a spinner to train the patient's swallowing.
4. Esthetic crown lengthening to correct the gingival level of teeth 15 (upper right second premolar) to 25 (upper left second premolar), using a clear acrylic periodontal stent with a 3-month healing period to create symmetry.
5. Home whitening with 10% carbamide peroxide for 2 weeks to provide the patient with the whiter teeth she desired.
6. Ceramic veneers on teeth 13 to 23; to restore the median diastema and old resin composite veneers. Acrylic retainers would be provided to maintain tooth alignment post-treatment.

Prior to treatment, the dentist assessed the size of the teeth, calculating the esthetic proportion of the teeth. The Recurring Esthetic Dental (RED) proportion is an objective numerical concept as a guide when designing smiles. The RED proportion states that the proportion of the successive widths of the maxillary teeth as viewed from the front should remain constant, progressing distally [14]. Ward stated that a 70% RED proportion is suitable for normal-length teeth with a 78% width/height ratio of the upper central incisors [15]. The use of a diagnostic wax setup was very important. This setup determined the case requirements and helped formulate the treatment plan. Furthermore, the setup helps the operator to visualize what the tooth size (width and height) and position of the teeth should be, as well as making it easier for the restorative dentist to communicate the desired outcome of the treatment with the patient during the treatment planning stage.

## TREATMENT PROCEDURES

Figure 6 shows treatment timeline of all procedures.

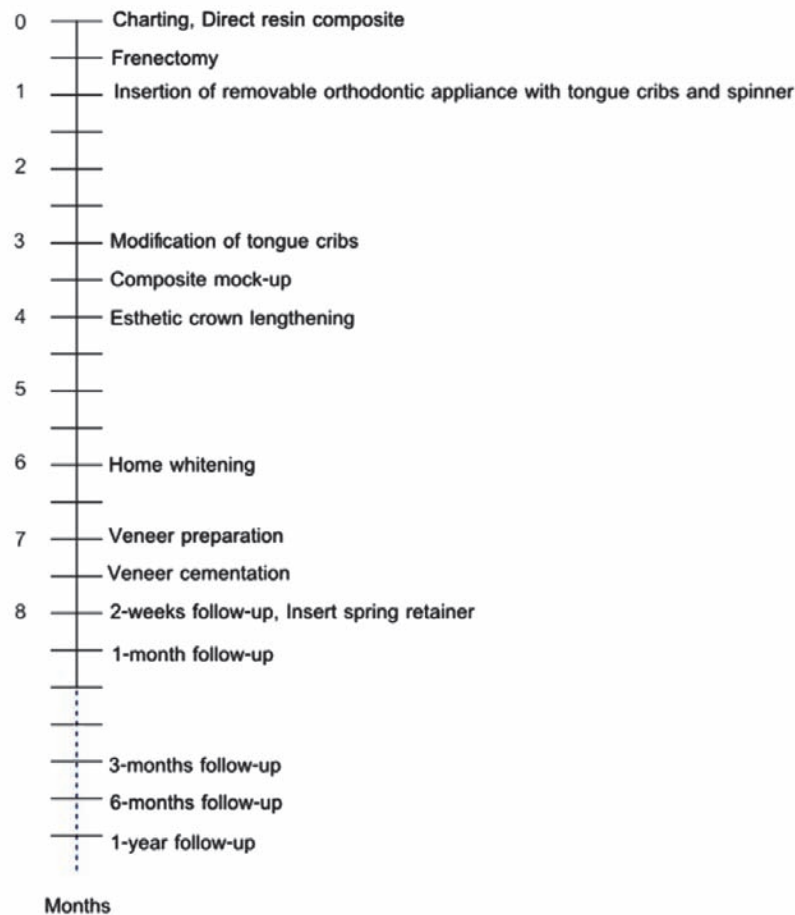


Figure 6 The treatment timeline.

### 1. Direct Resin Composites

Resin composite was placed on the mesial-incisal aspects of teeth 11 and 12. The enamel surface and broken part of old composite veneers were etched with 37.5% phosphoric acid gel (Kerr Gel Etchant, Kerr, Orange, CA, USA) for 15 seconds and water rinsing. Then, an alcohol-based adhesive system (OptiBond FL; Kerr, Orange, CA, USA) was applied and light-cured. A thin layer of universal nanofilled restorative material A3.5 shade (Premise, Kerr, Orange, CA, USA) was then added. Finally, the resin composite was contoured, finished, and polished.

### 2. Frenectomy

A frenectomy was performed under local anesthesia on the lingual frenum of the tongue. The frenum was held with a small curved hemostat

with the convex curve facing the ventral surface of the tongue. The first incision followed the curvature of the hemostat, cutting through the upper aspect of the frenum. The second incision was at the lower aspect of the frenum. The fibrous tissue at the wound edges were dissected with the tips of blunt-ended scissors. Absorbable Vicryl 4-0 sutures (Ethicon/Johnson & Johnson, Somerville, NJ, USA) were used to close the wound (Figure 7).

### 3. Myofunctional Exercise and Removable Orthodontic Appliance

Management of the tongue thrust, requires some specific behavioral activities, include the following [16, 17]:

(1) Education regarding the importance of proper tongue and lip postures when at rest and when swallowing.



- (2) Awareness training to establish appropriate resting postures for the lips and tongue.
- (3) Exercises to develop an appropriate swallow movement.

The components of the removable appliance consisted of: Adam's clasps at the left and right first upper molars (engaging the mesio-buccal and disto-buccal undercuts of the first molars for retention); a labial bow (to retain the teeth); cribs (to prevent tongue thrusting); a spinner (to do

myofunctional exercise) and the acrylic body of the appliance (Figure 8 A, B).

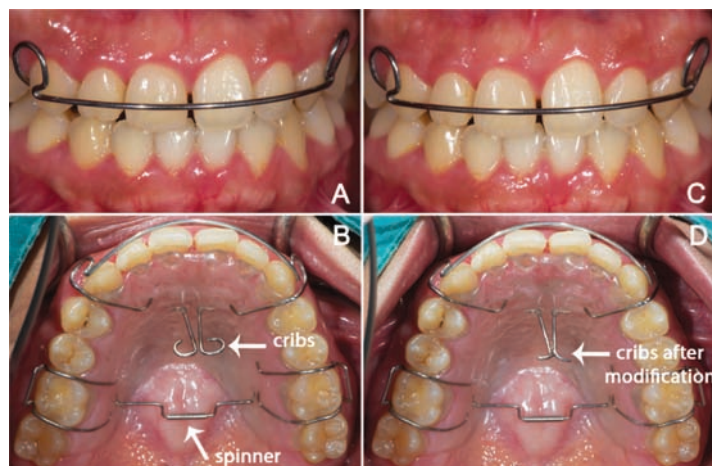
The patient was instructed to wear the appliance 24 h a day, to remove the appliance when eating or brushing, and to do myofunctional exercise everyday for 10 min per day. Ask the patient to begin to take a sip of water, place the tip of tongue on spinner, bite teeth together, then swallow with teeth together and tongue in correct position. After 2 months, the tips of tongue cribs were modified using cutting pliers, and the tips were polish with rubber polishing points to ensure that the patient could swallow without tongue thrusting habit (Figure 8 C, D). The cribs act as a barrier against the thrusting tongue and works as a mechanical restrainer. This is to avoid the tongue from thrusting over the tip of the crib.



**Figure 7** Frenectomy procedure: frenum removed (A), wound sutured (B), sutures removed (C). After the frenectomy, the patient could protrude the tongue normally (D).

#### 4. Esthetic Crown Lengthening

A wax-up model of the six anterior teeth was created before esthetic crown lengthening was performed to determine the proper relationship of the gingival level of each tooth (Figure 9). A silicone jig was made from the model and a temporary material, A1 shade (LuxaTemp®, DMG America, Englewood, NJ, USA) mock up was then fabricated to communicate with the patient and determine the correct gingival level.



**Figure 8** The removable appliance before (A, B) and after modifying the tips of tongue cribs (C, D)

Esthetic crown lengthening was performed on the gingiva of teeth 15 to 25 in order to improve the gingival margin level. An ethylene vinyl acetate vacuum tray was fabricated from a stone model created from the wax-up. The vacuum tray served as a surgical stent during the esthetic crown lengthening procedure. Under local anesthesia, we inserted the clear acrylic periodontal stent and made an incision for the gingivectomy. First, the dentist made an external incision following the margin of the stent from the diagnostic wax-up. An internal bevel incision was then performed. Any excess gingival tissue was removed and crestal bone contouring was performed, maintaining a 3-mm space relationship between the crest of the bone and the new gingival margin for the biologic width maintenance and installation of prosthesis. The creation of a precise biologic width requires, in addition, a precise osseous contouring, which was performed using manual instruments (surgical chisels) and carbide/diamond burs with adequate irrigation for preventing bone necrosis. The buccal bone of teeth 14 (upper right first premolar), 13, 23, and 24 (upper left first premolar) was contoured. The soft tissue was repositioned and sutured with 4-0 and 5-0 Vicryl (Ethicon/Johnson & Johnson, Somerville, NJ, USA) sutures. The sutures were removed 7 days after surgery, followed by a healing period of 1 month under observation (Figure 10).



**Figure 9** A wax-up model of the six anterior teeth was created to determine the proper relationship of gingival level of each tooth.

## 5. Home Whitening

The teeth were whitened using bleaching trays and 10% carbamide peroxide (Opalescence<sup>®</sup>, Ultradent Products Inc., South Jordan, UT, USA) on teeth 15 to 25 and 35 (lower left second premolar) to 45 (lower right second premolar) for 2 weeks. The bleaching trays were fabricated from a 0.035-inch-thick, 5x5-inch soft tray material (Sof-Tray, Ultradent Products, South Jordan, UT, USA). The trays were trimmed to 2 mm below the gingival line. The patient was instructed to wear the bleaching trays containing 10% carbamide peroxide gel approximately 6 hours per day for 2 weeks, to apply the gel on the labial inner surface of the tray at teeth 13, 21, 22, 23, 35-45, and on the lingual inner tray surface at teeth 11 and 12. The patient's tooth shade before home bleaching was comparable with Vita Classic shade A3 (Vitapan<sup>®</sup> classical; Vita Zahnfabrik, Bad Säckingen, Germany). Vita Classic shade B1 was achieved after 2 weeks of treatment.



**Figure 10** Esthetic crown lengthening was performed on teeth 15 to 25 (A-H).

## 6. Ceramic Veneers for the Anterior Maxillary Teeth

In the present case, after the esthetic crown lengthening, the gingival margin of tooth 12 was lower than that of the gingival margin of tooth 22. Electrosurgical gingivectomy (Dento-Surg<sup>®</sup> 90 FFP Radiosurgical Instrument, Ellman International Inc., Oceanside, NY, USA) was performed on the gingiva of tooth 12 on the day of veneer preparation.

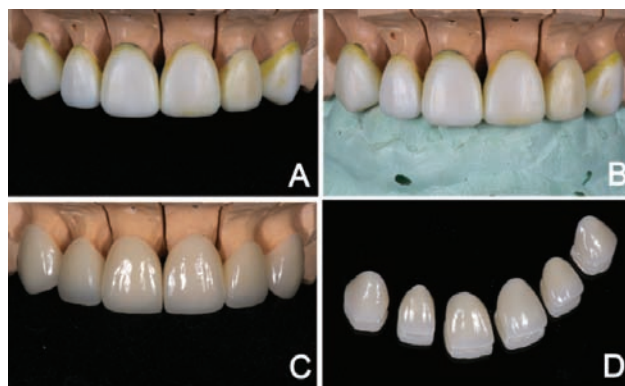
To minimize the invasiveness of the crown lengthening procedure, tooth preparation was performed using a silicone index derived from the diagnostic cast wax-up as a guide. A definitive margin of 0.5 mm beneath the gingiva was maintained (Figure 11). The six anterior maxillary teeth were prepared and retraction cord #000 (Ultrapak<sup>®</sup>, Ultradent Products Inc., Salt Lake City, UT, USA) was packed in the gingival sulcus. Impressions of the prepared teeth were taken with additional silicone (Flexitime<sup>®</sup>, Heraeus Kulzer South Bend, IN, USA) and sent to the dental technician to fabricate the ceramic veneers. Temporary restorations were made for the patient by the direct technique using light cure polymerizing composite resin, A1 shade (Premise, Kerr, Orange, CA, USA) and retained in place by spot etching without bonding. Prior to preparation, reference photographs of the teeth were taken, and ceramic veneers were fabricated and characterized accordingly. The working



**Figure 11** Tooth preparation for ceramic veneers was performed on maxillary anterior teeth.

model was fabricated and the wax patterns were completed. The ceramic veneers were fabricated using the pressing technique in LT translucency, A1 shade ceramic ingot (IPS e.max<sup>®</sup> Press, Ivoclar Vivadent, Schaan, Liechtenstein) with a layering of veneering ceramic to mimic the enamel halo. The gross characteristics, such as the mamelons and vertical/horizontal grooves were then fabricated on the veneers (Figure 12).

The fabricated veneers were examined on the stone dies and models to examine their fit and any flaws prior to the patient's appointment for cementation. The inner surfaces of the porcelain veneers were etched with 9% buffered hydrofluoric acid (Porcelain Etch<sup>®</sup>, Ultradent Products Inc., South Jordan, UT, USA) for 20 seconds, washed with water, and air-dried. A silane-coupling agent (Monobond-S, Ivoclar Vivadent, Schaan, Liechtenstein) was applied to the internal porcelain surfaces of the veneers with a fine-tipped brush and, after 60 seconds, gently air-blown with hot air from a hair drier. A thin layer of bonding agent (OptiBond FL, Kerr, Orange, CA, USA) was applied to the internal porcelain surfaces, air-blown, and left uncured. At the patient's visit for the veneers' permanent cementation, the temporary veneers were removed and the teeth were cleaned with wet pumice applied with a rubber cup. The

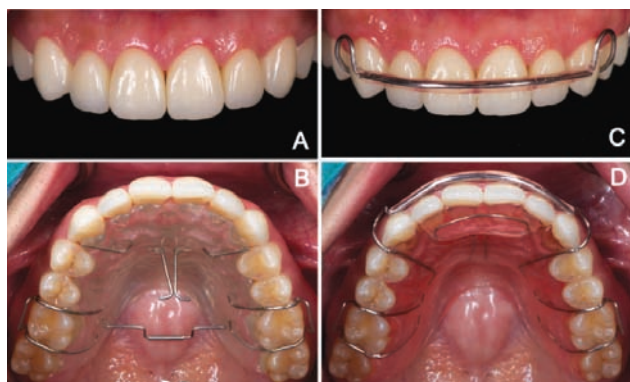


**Figure 12** The wax full contour veneers on the master cast (A, B). The veneers were fabricated from pressed ceramic with a layering of veneering ceramic to mimic the halo enamel (C, D).



adjacent teeth were separated using Teflon tape. The prepared teeth were etched with 37.5% phosphoric acid (Kerr Gel Etchant, Kerr, Orange, CA, USA). An alcohol-based adhesive system (OptiBond FL, Kerr, Orange, CA, USA) was then applied. The veneers were cemented using a photo-polymerized resin cement, clear shade (NX3 Nexus, Kerr, Orange, CA, USA). The cemented veneers showed excellent incisal translucency, youthful characterization, and natural color. The patient was instructed on how to take care of her restorations, and was provided with two retainers (Figure 13). The first retainer was modified from the previous removable orthodontic appliance by removing the labial bow with cutting pliers and polishing with rubber polishing points. The patient was given instructions to wear the retainer once a day for 5 min to maintain correct swallowing. The second retainer was a spring retainer to maintain tooth alignment after treatment and the patient was given instructions to wear this retainer at all times, except when eating, during the first month. After the first month, the patient could opt to wear the retainer at night. The patient also received instructions on cleaning procedures for maintaining the hygiene of the retainers, and a cleaning solution was provided.

At the follow-up evaluation 6 month after cementation, the veneers exhibited exceptional results. Most importantly, the patient was very satisfied with her new, confident smile (Figure 14).



**Figure 13** Retainers delivered to the patient (A, B, C, D).

At the 1-year evaluation (Figure 15, 16), the patient did not report tongue thrust swallowing, tooth sensitivity, or any adverse reaction. The restorations were in excellent condition, together with maintenance of good oral hygiene, resulted in satisfactory esthetic results and a good gingival response. No breakage or discoloration of veneers was observed during the evaluation.

## Discussion

Maxillary anterior spacing is a major reason why adults are motivated to seek orthodontic or restorative treatment. Frequently, they hope a simple removable appliance or composite bonding will provide immediate and uncomplicated correction of their problem. In reality, the complexity of the treatment will depend upon the etiological factors that have resulted in this condition. Thorough diagnosis of these contributing factors is essential to the success of the treatment [18,19]. Diastema treatment involves the correct diagnosis and early intervention relevant to its specific etiology. Different treatment modalities include removable orthodontic appliances, full arch, single arch or



**Figure 14** Pretreatment photos (A, B) and follow-up 6 months after treatment (C, D).

sectional fixed orthodontic appliances, excision of the frenum, restoration techniques, extraction of mesiodens, habit breaking appliances, etc. [20-22].

The diastema in the present case was attributed to tongue-tie and a tongue thrusting habit. Tongue-tie limits the upward movement of the tongue, preventing the formation of a lip seal during swallowing, leading to tongue thrusting, which can cause open bite [23]. It is not uncommon to see patients who display anterior spacing as a result of habits. Fingers, tongue thrusting, or occupational causes can displace teeth. These habits result in undesirable forces that move teeth vertically and laterally, thereby resulting in spaces between the affected teeth. Thus, our patient was considered a candidate for surgical frenectomy correction. Frenectomy corresponds to the complete excision of the frenulum. This procedure is more invasive and difficult than frenotomy (the clipping of the lingual frenulum), although the results are more predictable, decreasing the recurrence rate [24,25].

The patient was subsequently instructed to wear a removable appliance with tongue cribs and a spinner to prevent the tongue thrusting habit and for myofunctional exercise, respectively. It is

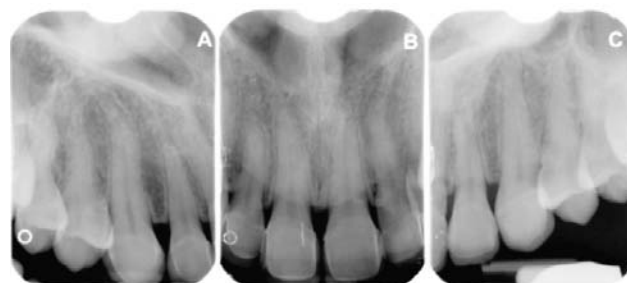
important for dentists to understand the effect of tongue function in the correction of malocclusion and stability after treatment. Cheng et al [13] proposed that all tongue dysfunctions should be corrected if long-term stability of treatment results is desirable. Myofunctional therapy is often indicated for correction of tongue thrust swallowing. It has been demonstrated that both myofunctional therapy and crib appliance are successful in correcting tongue thrust swallowing [26-28].

The important considerations in using an appliance are correct construction and patient education. The tongue cribs should have sufficient length to prevent forward positioning of the tongue beneath the cribs. The patient should be instructed to place their tongue behind the cribs when swallowing. It is critical that the habit is eliminated as orthodontic therapy is rendered to align the teeth and close the spaces. A well-designed fixed or removable retention appliance will be essential in order to prevent relapse of the spacing. Frequently, the retention appliance is modified to aid in controlling the troublesome habit.

A treatment plan is necessary as an aid in communicating to the patient what is required in their multidisciplinary treatment. A diagnostic wax-up is an initial visualization tool useful in representing the desired outcome of the treatment. The wax-up model can be used as a guide to communicate with the patient and other doctors who are involved in the treatment. To depict the



**Figure 15** Post-operative photos of the maxillary teeth, occlusal (A), right (B), frontal (C), left (D), and occlusal of the mandibular teeth (E) at the 1-year follow-up.



**Figure 16** Post-operative periapical radiographs at the 1-year follow-up (A, B, C).

overall treatment outcome, the first diagnostic wax-up with the desired gingival margin was made after the patient agreed to begin treatment. The diagnostic wax-up and mock-up were used to explain how a proportional balance of dental and gingival tissues influences the esthetics of facial soft tissue, especially in the perception of tooth size that can result in an unpleasing smile when excessive gingival tissue is displayed [29].

Crown lengthening is performed for esthetic improvement during restorations and in teeth with subgingival caries or fractures; in addition, this surgical procedure can establish an accurate bone width [30] and correct gingival asymmetries [31]. The ultimate goal of crown lengthening is to provide a tooth crown dimension adequate for a stable dentogingival complex and for the placement of a restorative margin, so as to achieve the best marginal seal and an esthetically pleasing final restoration. Maintaining a 3-mm distance from the marginal gingiva to the alveolar bone crest is highly recommended to ensure an adequate biologic width maintenance and installation of prosthesis. Impinging on this biological zone results in gingival inflammation, pocket formation, and eventually alveolar bone loss [32]. After esthetic crown lengthening, the soft tissue matures in approximately 7 weeks, whereas the hard tissue can take up to 6 months. For patients with major esthetic concerns, it is suggested to wait as long as possible before final restoration to ensure a stable tissue position and gingival sulcus [33].

Tooth whitening was performed in our case to whiten the tooth color. Tooth whitening is a conservative and effective method to lighten discolored teeth and has become an integral component of esthetic dentistry. Among the different whitening modalities, in-office whitening offers the benefit of faster whitening results that can motivate the patient to continue treatment. It is also highly appreciated by patients that cannot comply with wearing trays. However, the prolonged chair-time, advocated use of light

activating units and higher incidence of tooth sensitivity were significant drawbacks that limited its use to patients that could afford the higher cost and would tolerate the tooth whitening induced sensitivity. Clinicians use professional at-home tooth whitening as their first treatment option to treat discolored teeth. Other benefits include relatively low cost for the whitening treatment, reduced chair-time, allocation of most of the task to the dental staff and lower incidence and severity of tooth whitening induced sensitivity when compared to in-office whitening using highly concentrated whitening material [34]. For our patient, home whitening was prescribed for 2 weeks, with an additional 2-week waiting period to ensure tooth color stability.

For the restoration of a median diastema and fractured composite veneers, porcelain laminate veneers are more esthetic compared with direct or indirect composite veneers and are considered to be a conservative approach. Direct composite veneers have shown a higher risk of failure compared with porcelain veneers at a 2.5-year evaluation [35]. Many of the new ceramic systems have impressive physical and mechanical properties [36]. IPS e.max is a lithium disilicate glass-based material, in which small needle-shaped crystals compress the surrounding glass matrix during cooling. The IPS e.max system was chosen for this study because it is a commonly used system with promising physical properties and optical characteristics that mimic the natural tooth [37, 38]. A retrospective study on the clinical outcomes of IPS e. max Press restorations after functioning up to 5 years show that IPS e.max Press has an ideal medium-term outcome. The 5-year cumulative survival rate of veneers was 97.2% and the ceramic failure rate of veneers was 1.7%. The failures mainly occurred in the first 3 months after cementation and the main reasons were ceramic chipping and fracture [39]. The survival rate of 182 porcelain laminate veneers that were bonded using correct adhesive techniques was found to

be 94.4% after 12 years [40]. Regular professional care and patient instruction are the key to ensure the longevity of porcelain laminate veneers. Our patient was instructed to regularly floss after routine tooth brushing. She was also advised to avoid chewing hard substances such as candy or ice, and to refrain from habits such as fingernail biting that might damage her restorations.

In conclusion, this case report presents the clinical manifestation of a median diastema due to tongue-tie and tongue thrusting. The treatment in esthetic cases often involves a multidisciplinary approach. Frenectomy and a removable orthodontic appliance corrected the tongue-tie and tongue thrusting habit. Esthetic crown lengthening corrected the gingival line. Home whitening was prescribed to whiten the teeth. Final restorations were obtained by placing ceramic veneers on the maxillary anterior teeth. As the result of treatment, the patient exhibited greater confidence with a new smile.

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## References

1. Gass JR, Valiathan M, Tiwari HK, Hans MG, Elston RC. Familial correlations and heritability of maxillary midline diastema. *Am J Orthod Dentofacial Orthop.* 2003;123(1):35-9.
2. Bernabe E, Flores-Mir C. Influence of anterior occlusal characteristics on self-perceived dental appearance in young adults. *Angle Orthod.* 2007;77(5):831-6.
3. Kerosuo H, Hausen H, Laine T, Shaw WC. The influence of incisal malocclusion on the social attractiveness of young adults in Finland. *Eur J Orthod.* 1995;17(6):505-12.
4. Gkantidis N, Kolokitha OE, Topouzelis N. Management of maxillary midline diastema with emphasis on etiology. *J Clin Pediatr Dent.* 2008;32(4):265-72.
5. Kumar S, Gandhi S, Valiathan A. Perception of smile esthetics among Indian dental professionals and laypersons. *Indian J Dent Res.* 2012;23(2):295.
6. Nainar SM, Gnanasundaram N. Incidence and etiology of midline diastema in a population in south India (Madras). *Angle Orthod.* 1989;59(4):277-82.
7. Segal LM, Stephenson R, Dawes M, Feldman P. Prevalence, diagnosis, and treatment of ankyloglossia: methodologic review. *Can Fam Physician.* 2007;53(6):1027-33.
8. Ballard JL, Auer CE, Khoury JC. Ankyloglossia: assessment, incidence, and effect of frenuloplasty on the breastfeeding dyad. *Pediatrics.* 2002;110(5):e63.
9. Chu MW, Bloom DC. Posterior ankyloglossia: a case report. *Int J Pediatr Otorhinolaryngol.* 2009;73(6):881-3.
10. Northcutt ME. The lingual frenum. *J Clin Orthod.* 2009;43(9):557-65; quiz 81.
11. Hanson ML, Barnard LW, Case JL. Tongue-thrust in preschool children. *Am J Orthod.* 1969;56(1):60-9.
12. Peng CL, Jost-Brinkmann PG, Yoshida N, Chou HH, Lin CT. Comparison of tongue functions between mature and tongue-thrust swallowing--an ultrasound investigation. *Am J Orthod Dentofacial Orthop.* 2004;125(5):562-70.
13. Cheng CF, Peng CL, Chiou HY, Tsai CY. Dentofacial morphology and tongue function during swallowing. *Am J Orthod Dentofacial Orthop.* 2002;122(5):491-9.
14. Ward DH. Proportional smile design using the recurring esthetic dental (red) proportion. *Dent Clin North Am.* 2001;45(1):143-54.
15. Ward DH. A study of dentists' preferred maxillary anterior tooth width proportions: comparing the recurring esthetic dental proportion to other mathematical and naturally occurring proportions. *J Esthet Restor Dent.* 2007;19(6):324-37; discussion 38-9.
16. Kellum GD. Orofacial Myology: Beyond Tongue Thrust In Michelle Ferketic and Kirsten Gardner (Eds.) ed.



- Rockville, MD: *American Speech-Language-Hearing Association*.; 1994.
17. Zante SM. Orofacial Myology: Beyond Tongue Thrust. In Michelle Ferketic and Kirsten Gardner (Eds.) ed. Rockville, MD: *American Speech-Language-Hearing Association*.; 1994.
  18. Tuverson DL. Anterior interocclusal relations. Part I. *Am J Orthod*. 1980;78(4):361-70.
  19. Tuverson DL. Anterior interocclusal relations. Part II. *Am J Orthod*. 1980;78(4):371-93.
  20. Campbell A, Kindelan J. Maxillary midline diastema: a case report involving a combined orthodontic/maxillofacial approach. *J Orthod*. 2006;33(1):22-7.
  21. Huang WJ, Creath CJ. The midline diastema: a review of its etiology and treatment. *Pediatr Dent*. 1995;17(3):171-9.
  22. Russell KA, Folwarczna MA. Mesiodens--diagnosis and management of a common supernumerary tooth. *J Can Dent Assoc*. 2003;69(6):362-6.
  23. Kotlow LA. Ankyloglossia (tongue-tie): a diagnostic and treatment quandary. *Quintessence Int*. 1999;30(4):259-62.
  24. Kupietzky A, Botzer E. Ankyloglossia in the infant and young child: clinical suggestions for diagnosis and management. *Pediatr Dent*. 2005;27(1):40-6.
  25. Manfro AR, Manfro R, Bortoluzzi MC. Surgical treatment of ankyloglossia in babies--case report. *Int J Oral Maxillofac Surg*. 2010;39(11):1130-2.
  26. Alexander S, Sudha P. Genioglossis muscle electrical activity and associated arch dimensional changes in simple tongue thrust swallow pattern. *J Clin Pediatr Dent*. 1997;21(3):213-22.
  27. Cayley AS, Tindall AP, Sampson WJ, Butcher AR. Electropalatographic and cephalometric assessment of myofunctional therapy in open-bite subjects. *Aust Orthod J*. 2000;16(1):23-33.
  28. Huang GJ, Justus R, Kennedy DB, Kokich VG. Stability of anterior openbite treated with crib therapy. *Angle Orthod*. 1990;60(1):17-24; discussion 5-6.
  29. Mack MR. Perspective of facial esthetics in dental treatment planning. *J Prosthet Dent*. 1996;75(2):169-76.
  30. Pradeep K, Patil N, Sood T, Akula U, Gedela R. Full mouth rehabilitation of severe fluorosed teeth with an interdisciplinary approach (6 handed dentistry). *J Clin Diagn Res*. 2013;7(10):2387-9.
  31. Fletcher P. Biologic rationale of esthetic crown lengthening using innovative proportion gauges. *Int J Periodontics Restorative Dent*. 2011;31(5):523-32.
  32. Kois JC. New paradigms for anterior tooth preparation. Rationale and technique. *Oral Health*. 1998;88(4):19-22, 5-7, 9-30.
  33. Pontoriero R, Carnevale G. Surgical crown lengthening: a 12-month clinical wound healing study. *J Periodontol*. 2001;72(7):841-8.
  34. Rezende M, Loguercio AD, Kossatz S, Reis A. Predictive factors on the efficacy and risk/intensity of tooth sensitivity of dental bleaching: A multi regression and logistic analysis. *J Dent*. 2016;45:1-6.
  35. Meijering AC, Creugers NH, Roeters FJ, Mulder J. Survival of three types of veneer restorations in a clinical trial: a 2.5-year interim evaluation. *J Dent*. 1998;26(7):563-8.
  36. Denry I, Kelly JR. Emerging ceramic-based materials for dentistry. *J Dent Res*. 2014;93(12):1235-42.
  37. Christensen GJ. The all-ceramic restoration dilemma: where are we? *J Am Dent Assoc*. 2011;142(6):668-71.
  38. Wang F, Takahashi H, Iwasaki N. Translucency of dental ceramics with different thicknesses. *J Prosthet Dent*. 2013;110(1):14-20.
  39. Yang Y, Yu J, Gao J, Guo J, Li L, Zhao Y, et al. Clinical outcomes of different types of tooth-supported bilayer lithium disilicate all-ceramic restorations after functioning up to 5 years: A retrospective study. *J Dent*. 2016;51:56-61.
  40. Fradeani M, Redemagni M, Corrado M. Porcelain laminate veneers: 6- to 12-year clinical evaluation-a retrospective study. *Int J Periodontics Restorative Dent*. 2005;25(1):9-17.

