

Treating a maxillary midline diastema in adult patients: A general dentist's perspective

**C.H. Chu, BDS, MDS, PhD, C. F. Zhang, DDS, MDS, PhD, L. J. Jin, DDS, PhD,
Odont Dr**

Faculty of Dentistry, The University of Hong Kong

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Correspondence to :

Dr. C. H. Chu
Faculty of Dentistry
The University of Hong Kong
34 Hospital Road
Hong Kong SAR, China

Tel: (852) 2859 0287

Fax: (852) 2559 9013

E-mail: chchu@hku.hk

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Abstract

Background: *Maxillary median, or midline, diastema (MMD) is often a main concern for patients during a dental consultation. Although MMD can be transient owing to the developing dentition and thus require no active treatment, management of MMD in permanent dentition in adults requires a detailed examination and subsequent appropriate care.*

Case Description: *Five cases of MMD in adult patients are presented to illustrate a range of restorative and orthodontic options to manage MMD. In the first case, composite build-up was used to close an MMD due to small teeth and generalized spacing in the dental arch. In the second, porcelain veneers were applied to manage an MMD with discolored dentition. In the third, a removable appliance was fitted to close an MMD by tipping the incisors palatally. In the fourth, a sectional fixed appliance was fitted to promote mesial bodily movement of the incisors. In the fifth, a full-arch fixed appliance was used to manage an MMD due to tilted incisors.*

Conclusions and Clinical Implications: *Effective treatment requires correct diagnosis and intervention relevant to its etiology. A range of restorative and orthodontic treatment could be provided by general dentist in appropriate clinical situation to address patient's concern of MMD.*

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The presence of a space between the two upper central incisors—maxillary median diastema or maxillary midline diastema (MMD)—is considered a normal developmental phenomenon in children and requires no treatment. A study from the UK reported that about two thirds of children in whom only central incisors had erupted showed MMD.¹ However, a MMD of greater than 2 mm in mixed dentition is unlikely to close spontaneously² and may persist in the permanent dentition. MMD can be genetically inherited and more prevalent in certain ethnicities. Gass et al.³ reviewed the literature and reported the prevalence ranged from 1.6% to 25.4% adults from various populations and age groups. They also reported that MMD is more common among black people than among whites, Asians, or Hispanics.³

Keene⁴ defined MMD as a space greater than 0.5 mm between the proximal surfaces of the two central incisors, because a gap wider than this threshold starts getting noticeable. Indeed, McKnight et al.⁵ reported that MMD is considered esthetically less favourable than mild fluorosis or isolated opacity. MMD can also adversely affect body image and self-esteem, and can be one of the most negative influences on self-perceived dental appearance.⁶ A study in Finland found that people with MMD might be perceived as less intelligent, less beautiful, and less sexually attractive, and judged to belong to a lower social class.⁷ Therefore, MMD can be regarded as unappealing and as a chief patient complaint. In addition to poor esthetics, patients who request MMD closure may also complain of impaired speech, lip biting, and adverse psychological effects. Effective treatment of MMD requires correct diagnosis and intervention relevant to its etiology. Before formulating a definitive treatment plan for MMD, it is important to understand the etiology of the problem, which can be an anomaly in number (such as mesiodens or hypodontia) or size (such as microdontia), an enlarged labial frenum, abnormal habits (such as tongue thrusting or finger biting), and advanced periodontitis. A comprehensive history, including the duration of the diastema, changes in size, any past orthodontic treatment, and family history is essential. The clinical examination should include inspection of the dentition and occlusion, labial frenum and lips, and periodontal condition. Full-mouth periapical radiography is necessary to assess periodontal support. Study models should also be taken, and a diagnostic wax-up can be used to

illustrate the possible results of treatment options. In general, the “golden proportion” (8:5) as the ratio of the mesio-distal crown width of the central incisor to that of the lateral incisor can be used as a guideline for esthetic evaluation. Last, but not the least, the patient’s preferences, which are affected by psychological, physical, financial, and time factors, are key to delivering successful dental treatment. This article presents five cases to illustrate management of MMD in a general dental office. The MMDs were closed using direct composite build-up, porcelain veneers, a removable appliance, a sectional fixed appliance, and a full-arch fixed appliance.

Case No. 1 – Treatment with composite build-up

Assessment and treatment

A 20-year-old woman was unhappy with her smile (Figure 1) and the spacing in her upper teeth, particularly between her two central incisors (Figure 2). Clinical examination revealed generalized spacing in her upper and lower teeth due to a discrepancy in the size of her teeth and dental arches. Impressions were taken to prepare a study cast and diagnostic wax-up (Figure 3). After a discussion of the treatment options, composite resin build-ups were performed on her four upper incisors to close the spacing between her upper anterior teeth.

The incisors were cleaned with pumice but no tooth preparation was performed. Composite resin (A2 shade) was added to close the space on the central and lateral incisors. The emergence profile of the incisors in the cervical regions was followed during composite build-up to ensure a smooth lingual to buccal finish (Figure 4). The composite restoration margin was thinned and merged to the enamel surface. The patient was very satisfied with this simple non-invasive treatment (Figure 5), even though the spacing in her lower teeth still persisted (Figure 6).

Discussion

Making a diagnostic wax-up and study cast necessitates an extra appointment, but doing so provides a record, aids communication, and allows ample time for the patient to evaluate the treatment outcome outside the dental clinic. Moreover, a silicon index can be fabricated from the study cast to aid direct composite build-up. Dalvit et al.⁸ advocated a simple chair-side try-in method using ortho-wax, but considerable chair-side time may be needed to evaluate the outcome for some patients. In addition, once the wax is removed, the patient cannot reevaluate it again.

Composite build-up is a simple, direct, and relatively low-cost restorative treatment. It is also reversible and does not exclude orthodontic treatment in the future. Willhite⁹ proposed three criteria for successful diastema closure: (1) an increased emergence profile with natural contours at the gingival-tooth interface; (2) a completely closed gingival embrasure (i.e. no black triangle); and (3) a smooth subgingival margin that does not catch or shred dental floss during flossing. The mesial surface of the natural teeth can be rounded into the facial surface to give a natural bevel for the composite restoration. The composite resin used for direct build-up should be non-sticky and non-slumping, and should contain a high (>65%) filler content by volume and have a particle size smaller than 5 microns. Composite changes color over time, and leakage may occur around the margin, so touch-ups to composite are usually required every 7 to 10 years.¹⁰ Composite build-up can fracture or debond, so proper bonding technique and good moisture control are essential. Limiting exposure to direct force on the incisal edge substantially minimizes the risk of fracture.¹¹ The deterioration of the material in terms of shade and texture and the possibility of dislodgement of the build-up should be discussed with the patient beforehand.

Case No. 2 – Treatment with porcelain veneers

Assessment and treatment

A 28-year-old man complained of the presence of an MMD when he smiled (Figure 7). His teeth were also discolored by tetracycline staining (Figure 8). Porcelain veneers was used to close the MMD and mask the discoloration of his dentition.

To accommodate the thickness of porcelain veneer, a layer of enamel of about 0.5 mm thick was removed with diamond burs (Laminate Veneer System, Brasseler, Savannah GA; 1-800-841 4522) (Figure 9). The incisal edge was prepared and made to extend minimally onto the palatal surface as a heavy chamfer; however, it extended into the gingival proximal area for esthetic reasons. Care was taken to prevent the creation of undercut areas and unnecessary exposure of the dentin. Proximal contact areas were not involved in the preparation, thereby making the preparation fast and easy, while conserving tooth structure. The prepared teeth were treated with a three-step bonding agent (Scotch Bond MP, 3M/ESPE St. Paul, MN 1-888-364-3577) before taking an impression. Temporization was not provided because the patient wanted to save the cost

of the temporary restorations and was satisfied with his appearance during treatment. The porcelain veneers were made of pressed porcelain ingots (IPS Empress 2, Ivoclar Vivadent, Bendererstrasse, Germany 004-23- 235-3535).

When the patient returned for veneer cementation, the teeth were cleaned with pumice and the correct shade was selected with water-soluble try-in paste (Variolink II, Ivoclar Vivadent, Bendererstrasse, Germany 004-23-235-3535). Although the shade of the final restorations could be modified by colored luting cement, only limited shade adjustments would have been possible. A strong opaquer could have been used, but the final restorations would have no longer looked natural. A light pink opaquer was thus used to produce a Vita shade of A3.5. Cementation started with the two central incisors, followed by the lateral incisors and so on, ensuring correct positioning during bonding. After light curing of about 2 seconds, excess cement was removed before the final thorough curing of at least 40 seconds. The patient was reviewed after 1 week (Figure 10). He was satisfied with his veneer treatment (Figure 11). Porcelain veneers are strong when bonded to teeth, but they can fracture as a result of excessive chewing and grinding. This was explained to the patient and a night guard was prescribed.

Discussion

Because the color of the enamel layer comes from the dentin, preparing teeth that have tetracycline staining would make the enamel appear darker owing to an increased chroma and a reduced value. Fabricating a porcelain veneer with good esthetics is very challenging, and the patient's expectation of esthetics must be evaluated before treatment. Porcelain is far more superior in mechanical properties and in esthetics than composite. It also lasts longer and shows little staining. However, it requires tooth preparation and is expensive. If appropriate tooth preparation is not carried out, the teeth could appear over-contoured and bulky, which would induce gingival inflammation owing to an improper gingival profile. It is also desirable that at least half of the prepared surface remain in enamel because porcelain veneer bonded to dentin is prone to fracture.¹²

In this case, proximal preparation of the central incisors was performed to create appropriate mesio-palatal contours so as to minimize the problem of food trapping and irritation to the tongue. Magne et al.¹³ advocated immediate dentin sealing before taking the working

impression to minimize postoperative dentin hypersensitivity. Temporary veneers also help to protect the teeth from developing sensitivity and to improve esthetics. To achieve success in veneer treatment, it is important to consider the following crucial elements in esthetic design: facial midline, incisal embrasures, axial inclinations, shade progression, tooth reveal, vestibular space, and smile line.¹⁴

Case No. 3 – Treatment with a removable appliance

Assessment and treatment

A 19-year-old man asked for closure of the space between his two upper central incisors (Figure 12). Cephalometric analysis revealed normal anatomical landmarks such as SNA, SNB, and mandibular plane angles, but an increased angle between his upper incisors and maxillary plane (Figure 13). The lower teeth were well aligned. The treatment plan was to close the MMD using a removable upper appliance containing a Robert's retractor. The acrylic baseplate was trimmed back to allow retraction of the central incisors. The extension and position of the Robert's retractor was checked to make sure it rested on the buccal sulcus with no distortion, and the loop was adjusted to prevent it from contacting the attached or free gingivae. Otherwise, the patient would have experienced pain and mucosal ulceration. The patient was asked to wear the removable orthodontic appliance 24 hours a day. The first review appointment was the following day to check for discomfort. At the next review appointment after 4 weeks, excellent compliance to the 24-hour regimen had been achieved; the space was closed after 3 months (Figure 14). The patient wore a Hawley-type removable retainer full-time for 6 months (Figure 15) and then every night for about 12 hours for another 6 months. The patient was satisfied with the results at the 12-month review (Figure 16). He was encouraged to continue wearing a heat-cured retainer at night to prevent relapse.

Discussion

Although most orthodontic cases requiring a removable orthodontic appliance can be treated with a fixed appliance, a removable appliance can be a good option for patients who want a less expensive option. In addition, oral hygiene maintenance is simpler for removable than for fixed appliances. In this case, the MMD was closed by tipping the incisors palatally and reducing the width of the upper arch. Root repositioning was not required. Generally, MMDs should be no

more than 3 mm wide for this method of treatment.² There should also be ample room between the upper and lower anterior incisors for the palatal retraction of the upper incisors. The periodontal condition must be good and stable. A slight increased overjet, reduced overbite, and proclined upper incisors are favorable because these will be improved with the retraction of incisors. Case selection is vital for a successful outcome, as is the patient's adherence to the treatment regimen. Apart from wearing the retainer, good support of posterior teeth is needed to maintain stability of the treatment outcome.

A removable appliance has three main components. The first is the retention device, which in this case was achieved by an Adam's clasp, which was placed on the maxillary first molars. The second is the active component; in this case, it was a Robert's retractor and was designed to tip the incisors palatally for space closure. The removable appliance tips teeth with little bodily movement. The optimal force used is 25 to 40 g; any smaller or larger a force will affect tooth movement. The final component is the acrylic baseplate, which joins the different components together. The Robert's retractor is made of 0.5mm stainless steel wire and is reinforced by tubes on both sides for rigidity. A loop is included for greater resilience and ease of adjustment. The acrylic baseplate, which is not a denture, should not extend too far posteriorly to ensure a comfortable fit. A regular oral hygiene maintenance program should be scheduled to ensure good plaque control. As the patient in this case was asked to use the retainer for an extended period of time, a heat-cured retainer was made to increase polymerization and reduce porosity.

Case No. 4 – Treatment with a sectional fixed appliance

Assessment and treatment

A 19-year-old woman wanted to close her MMD (Figure 17) but could not afford either the time or cost of treatment with a comprehensive fixed appliance. Her oral hygiene was not satisfactory. Clinical examination reviewed localized marked gingivitis, a rotated upper canine, and an MMD (Figure 18). She had no other concerns or problems regarding tooth alignment, function, or esthetics except the MMD. Treatment options and the importance of oral hygiene were explained, and the MMD was closed with a sectional fixed appliance after resolution of the gingival inflammation.

Four orthodontic brackets were bonded onto the upper incisors and a 16-mil round stainless steel wire was inserted and stabilized with elastic ligatures. Loops were created using loop-forming pliers at both ends of the wire to prevent lateral sliding and dislodgement of the wire. The 16-mil wire was replaced with 18-mil round stainless steel wire after 4 weeks, and an elastomeric chain was used to close the MMA. The power chain spanned from the mesial wing of one lateral incisor bracket through the brackets of central incisors to the mesial wing of the wing of the other lateral incisor (Figure 19). The power chain was replaced with a new chain at the 1-month follow-up. On MMD closure, after 4 weeks, the spacing was redistributed to the proximal areas of the lateral incisor and canine. A metal ligature was then applied to ligate the 4 incisors and stabilize the result for 3 months. Figure 20 shows the results after removal of the brackets. Her MMD was closed and her oral hygiene was improved. Finally, a removable retainer was fitted and instructions on retainer wear were given, as for case no. 3. The patient was very happy with the results of this simple and inexpensive orthodontic treatment (Figure 21).

Discussion

When MMD is the only concern of the patient and the alignment of the teeth is acceptable, a sectional arch wire can be used to close the MMD. This method can be a suitable option when time and cost prohibit comprehensive treatment with a fixed appliance. In this case, the incisors were moved mesially to close the MMD. Initial fitting of a 16-mil round wire allowed better alignment of the four incisors before active movement. An 18-mil wire provided enough strength to ensure the incisors were pulled by the elastics to achieve the desired mesial movement. Alternatively, a coil spring could have been fitted, but this is a less convenient method. Caution must be taken not to overstretch the power chain, as this can cause unwanted mesial rotation of the lateral incisors if the power chain connects the distal wing of one bracket to the distal wing of the other.¹⁵ A rectangular (16 x 22 mil) arch wire can be used for 3-dimensional control. Care should be taken when using this simple sectional fixed appliance because incisors may act against each other and produce unwanted tooth movement. Alternatively, a “2 x 4 appliance” (molar bands on the two first molars and brackets on the four incisors), together with a utility arch, can be used to better control teeth movement. This method also prevent minor incisor flaring.

Wearing a removable retainer full-time for 6 months followed by prolonged or semi-

permanent part-time use (usually overnight) will provide good retention without compromising oral hygiene practices. Prolonged retention is recommended because there is little trans-septal fiber between the central incisors and relapse can be frequent. If the patient feels tightness during part-time wearing of the retainer, the duration of use per day should be extended or the treatment can even revert to full-time use. Retention can also be achieved by splinting the 6 anterior teeth together with a lingual wire. However, this approach will complicate oral hygiene practices, and flossing with a floss-threader is necessary.

Case No. 5 – Treatment with a full-arch fixed appliance

Assessment and treatment

A 26-year-old woman complained of an MMD (Figure 22). Her molar and canine had a normal Class I relationship. Distal tilting of the two central incisors was also present, but there was adequate spacing in the upper arch. Since the patient's lower teeth were reasonably aligned and she had no other complaints, treatment consisted of closing the MMD by re-aligning the two upper central incisors with a full-arch fixed appliance. Orthodontic treatment started with the banding of the upper first molars and bonding of brackets from the left second premolars to the right second premolars. A 16-mil nickel-titanium (NiTi) wire was fitted with elastic ligatures to align the teeth horizontally, and a ligature wire was fitted to the canine and first molar to prevent mesial movement of the canine (tie-back) (Figure 23). The 16-mil NiTi wire was replaced with 18-mil NiTi wire after 2 months. It was then replaced with 18-mil stainless steel wire to promote mesial bodily movement. A power chain was fitted to close the space between the central incisors. The active fixed appliance treatment took 7 months (Figure 24). The patient was very satisfied with the treatment outcome (Figure 25). Finally, a removable retainer was fitted and instructions on retainer wear were given, as for case no. 3. The occlusion after active treatment was studied clinically and in the mounted study cast. No adjustment of the occlusion was made because the upper and lower teeth had achieved satisfactory occlusion.

Discussion

In this case of MMD with tilted upper central incisors, treatment involved controlled tooth movement. Use of a fixed appliance was a simple and fast treatment method. The alignment of the mandibular teeth was acceptable and there was adequate space to allow for the alignment of the

upper teeth. In such cases, a diagnostic set-up is necessary in the assessment. Space analysis can be performed in the study cast. If there is mild crowding in the upper arch, midline expansion can be achieved with a screw, quad helix, or Porter's arch. In general, a 1-mm midline expansion would provide 2 to 3 mm of space in the arch.² The first molars are banded to serve as anchorage, and a small-diameter arch wire is initially fitted and supported with brackets. After horizontal alignment of the teeth, a rectangular arch wire is necessary if the root positions need to be corrected. Detailed explanations, including the importance of follow-up and maintenance care, need to be given to patients.

Summary

MMDs create a dark spot within the smile, which prompts patients to seek treatment. General dentists have an important role in making correct diagnoses and should consider a multi-disciplinary approach for the best outcome. A detailed assessment should be provided and often includes radiographic assessment, space analysis, and occlusal analysis on study casts and the diagnostic wax-up. It is also essential to study the position and size of the tongue in relation to the dental arch.

Management may require specialist care depending on the etiological factors. Still, it is not uncommon to find no underlying pathology. When comprehensive orthodontic care is not the patient's choice of treatment and if function and alignment of the teeth are acceptable, restorative or simple orthodontic treatment can be provided. This paper has presented five scenarios and treatment methods that can be performed by general dentist to manage MMD. An algorithm for MMD management summarizing the cases and methods presented is shown in Figure 26. These methods are simple and treatment outcomes can be very satisfactory in addressing patient's concerns.

Disclaimer

Products discussed in this paper are not exclusive in the management of MMD. The authors have no financial interest in any of the products discussed.

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Author information

Drs. Chu and Zhang are clinical associate professors and Dr Jin is clinical professor in the Faculty of Dentistry, The University of Hong Kong.

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