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Congenitally Missing Mandibular Second Premolars: Clinical Options

Abstract:

Background: **Congenital absence of mandibular second premolars affects many orthodontic patients. The orthodontist must make the proper decision at the appropriate time regarding management of the edentulous space. These spaces may be closed or left open.**

Implications: **If space will be left open for an eventual restoration, the keys during orthodontic treatment are to create the correct amount of space and leave the alveolar ridge in an ideal condition to receive a restoration in the future. If space will be closed, the clinician must avoid altering the occlusion and facial profile in a way that would be detrimental to the patient.**

Significance: **Some of the decisions that the orthodontist makes early on in the life of a patient who is congenitally missing mandibular second premolars will affect these patients and their dental health for a lifetime. Therefore, the correct decision must be made at the appropriate time.**

Purpose: **This article will present and discuss a variety of treatment alternatives for managing the orthodontic patient who is congenitally missing one or both mandibular second premolars.**

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Learning Objectives

After reading this article, the reader should be able to:

- discuss treatment options for orthodontic patients who have congenital absence of mandibular second premolars.
- describe the criteria that should be considered in creating a treatment plan using a single-tooth implant.
- understand how the anatomy of young orthodontic patients can affect treatment outcomes.

Congenital absence of mandibular second premolars affects many orthodontic patients. The clinician must make the proper decision at the appropriate time regarding management of the edentulous space.[1] If space will be left open for an eventual restoration, the keys during orthodontic treatment are to create the correct amount of space and leave the alveolar ridge in an ideal condition to receive a restoration in the future. In the distant past, either conventional bridges or, more recently, resin-bonded bridges have been used to fill in the edentulous space. However, full-coverage conventional bridges in young patients can result in devitalization of the pulp and require root canal therapy.[2] Resin-bonded posterior bridges have a questionable survival rate.[3-5] Today, the first choice of restoration for a congenitally missing mandibular premolar should be a single-tooth implant.[6] But if the implant cannot be placed until the patient has completed facial growth, how should the edentulous ridge be preserved?

Ostler and Kokich[7] evaluated the long-term changes in the width of the alveolar ridge after extraction of mandibular primary second molars. Their data showed that the ridge narrows by 25% during the first 4 years after primary tooth extraction. After 7 years, the ridge narrows another 5%, for a total reduction of 30% over 7 years. However, these authors showed that these ridges were still broad enough to receive a dental implant. Unfortunately, the ridge resorbs more on the facial than the lingual and, therefore, although the implant can be placed without a bone graft, the implant position is more to the lingual. This factor requires that the restorative dentist alter the loading of the buccal and lingual cusps of the crown on the implant to avoid fracture of the abutment or the implant crown.[8]

Another option is to maintain the primary tooth until the patient is old enough to place the implant. The appropriate age for implant placement is determined by the cessation of vertical facial growth. That parameter is determined

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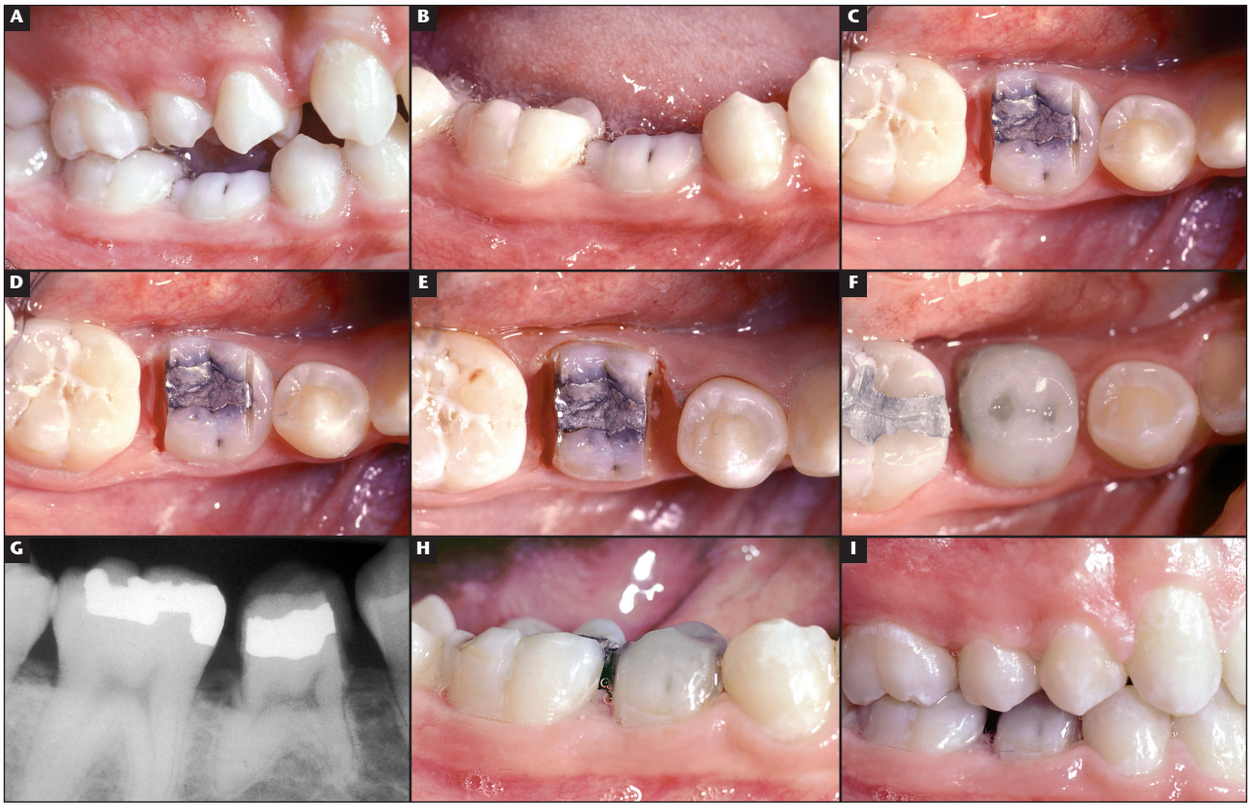

Figure 1 This adolescent female was congenitally missing her mandibular right permanent second premolar and the primary second molar was present and submerged below the level of the occlusal plane (A). The radiograph showed that the root had not resorbed (B). Since the bone levels were flat between the primary and adjacent permanent teeth, the tooth was maintained. The tooth was too wide (C), so the mesial and distal surfaces were reduced substantially (D,E). The tooth was built up with composite (F,G) in order to reduce the caries risk. The pulp was not damaged (G) after the space was closed (H) and the posterior teeth were brought into occlusion (H,I).

by comparing serial cephalometric radiographs to determine when ramus growth and, therefore, vertical changes in facial growth have stopped. Fudalej and coworkers[9] have shown that, on average, females continue facial growth until about 17 years of age, while the average male completes facial vertical growth at about 21 years of age. Therefore, maintaining the primary tooth until the cessation of growth is desirable. But primary molars are too wide mesiodistally, which could affect the fit of the posterior teeth. So, it is advantageous to reduce the width of the primary second molar to the size of a second premolar.[1]

The reduction of a primary molar should be accomplished with a sharp carbide fissure bur or a diamond bur. The key is to remove sufficient tooth structure to create space, but not enough to cause pulpal necrosis. A guide to estimating the correct amount of reduction is to measure the mesiodistal width of the primary molar at the level of the cementoenamel junction on a bitewing radiograph (Figure 1). This distance can be transferred to and marked on the occlusal surface of the primary molar using a pencil or marking pen. Then, the bur is positioned to follow this line and cut down toward the gingival to remove a wafer of enamel and underlying dentin on both the mesial and distal surfaces (Figure 1). About 2 mm may be removed from both mesial and distal surfaces, which should leave the crown about 7 mm to 8 mm wide.

A potential problem of reducing the primary molar in this way is that it leaves exposed dentin on the mesial and distal surfaces of the tooth. As the spaces are closed, it would be difficult for the patient to adequately clean these interproximal surfaces, and the tooth could decay easily. Therefore, in order to prevent decay, a layer of light-cured restorative composite should be applied to the mesial and distal surfaces to protect the primary tooth. In addition to protecting these exposed dentinal surfaces, the addition of restorative composite will build up the occlusal surface

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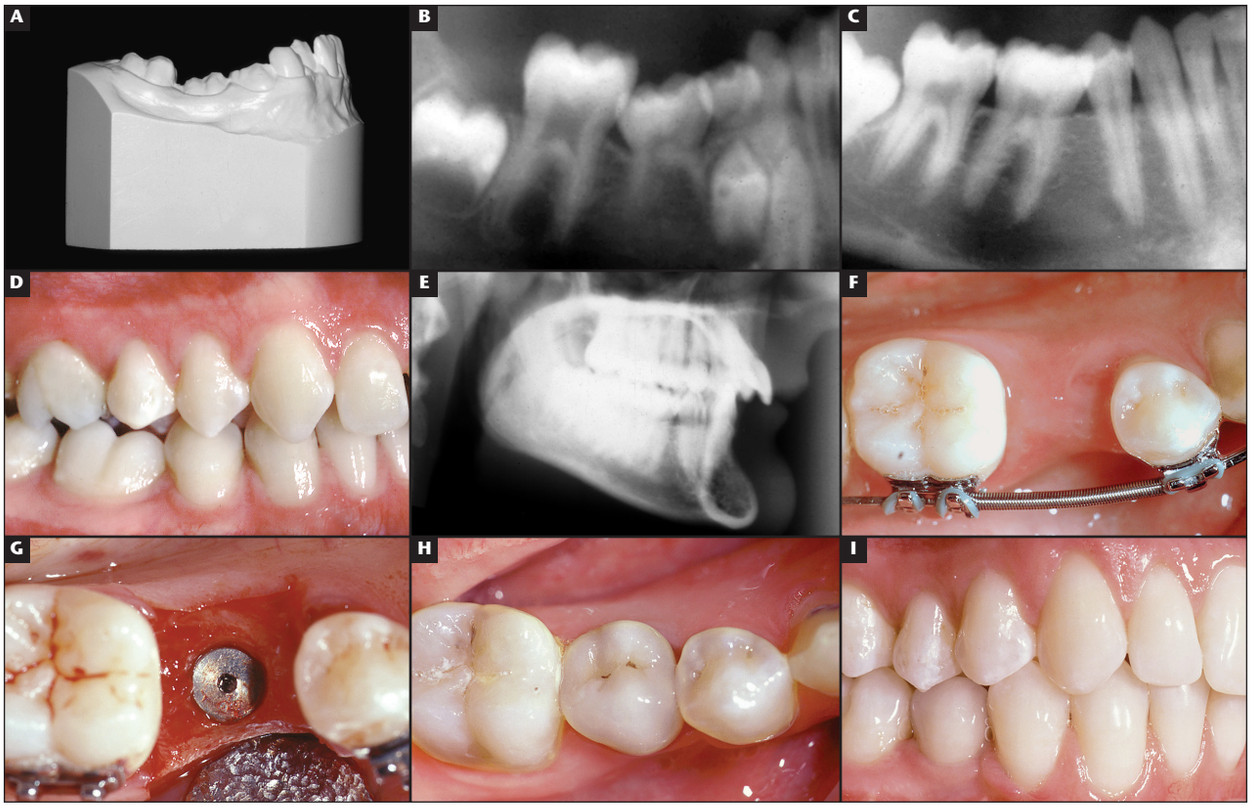

Figure 2 This female child was missing her mandibular right and left permanent second premolars, and the primary first and second molars were ankylosed and submerged (A,B). All primary molars were extracted and the permanent first premolar and first molar drifted toward one another and closed the space (C,D). Since the mandibular incisors were positioned lingually relative to the chin (E), the treatment plan involved opening of the second premolar space (F), followed by placement of an implant (G), and porcelain crown (H). This treatment plan resulted in an ideal Angle Class I occlusion after orthodontic treatment (I).

of the typically short primary molar, so it can function with the teeth in the opposing dental arch and prevent supereruption. After composite restoration, the interproximal spaces can be closed, and the primary molar now functions as a premolar (Figure 1).

A common concern about closing these interproximal spaces after reduction of the primary tooth is that the roots of the primary teeth will prevent complete space closure, because these roots tend to diverge beyond the width of the crown. However, in most cases, as the socket wall of the permanent teeth move near and into contact with the primary tooth roots, the latter will resorb. After resorption, these primary roots are replaced with bone, which is an ideal way to prepare this site for a future implant.[1]

Occasionally a primary second molar may become ankylosed. If the ankylosis occurs while the patient is young and still undergoing significant facial growth, then the tooth will become submerged relative to the adjacent erupting permanent teeth.[1] If this region will be restored with an implant in the future, then the alveolar ridge could be compromised vertically and require a bone graft.[10] However, vertical bone grafting is often unpredictable[11] and an added expense for the patient. Therefore, extraction of ankylosed primary molars is recommended if the patient is missing the primary second molar and still has significant facial growth remaining. But how does the clinician diagnose ankylosis in the child or adolescent? The most reliable indicator of primary molar ankylosis is to evaluate the alveolar bone levels between the primary molar and the adjacent permanent first molar and first premolar.[1] If the bone is flat, this indicates that the primary tooth and the adjacent teeth are erupting evenly. However, if the alveolar bone level becomes oblique, with the bone level located more apically around the primary tooth, this confirms ankylosis (Figure 2). If the patient has little facial growth remaining, and the primary molar is only submerged slightly, the tooth can be maintained in order to preserve the width of the alveolus for the future implant. However, if the patient has significant growth remaining, the primary molar must be extracted to avoid producing a significant ridge defect.

A common question after primary molar extraction is whether or not to place a space maintainer to preserve the arch length. Personally, we do not place space maintainers in most of these situations, especially if implants will be the choice of restoring the edentulous space. If the edentulous space is not maintained, the adjacent permanent first molar and first premolar should erupt together (Figure 2). Although this could require longer orthodontic treatment to push the teeth apart to create the implant space, this type of tooth movement will also result in a more robust alveolar ridge (Figure 2). As the roots of adjacent teeth move away from one another, they deposit bone behind that equals the width of the premolar and molar and will produce an excellent ridge in which to place the implant. This process is called orthodontic implant site development.

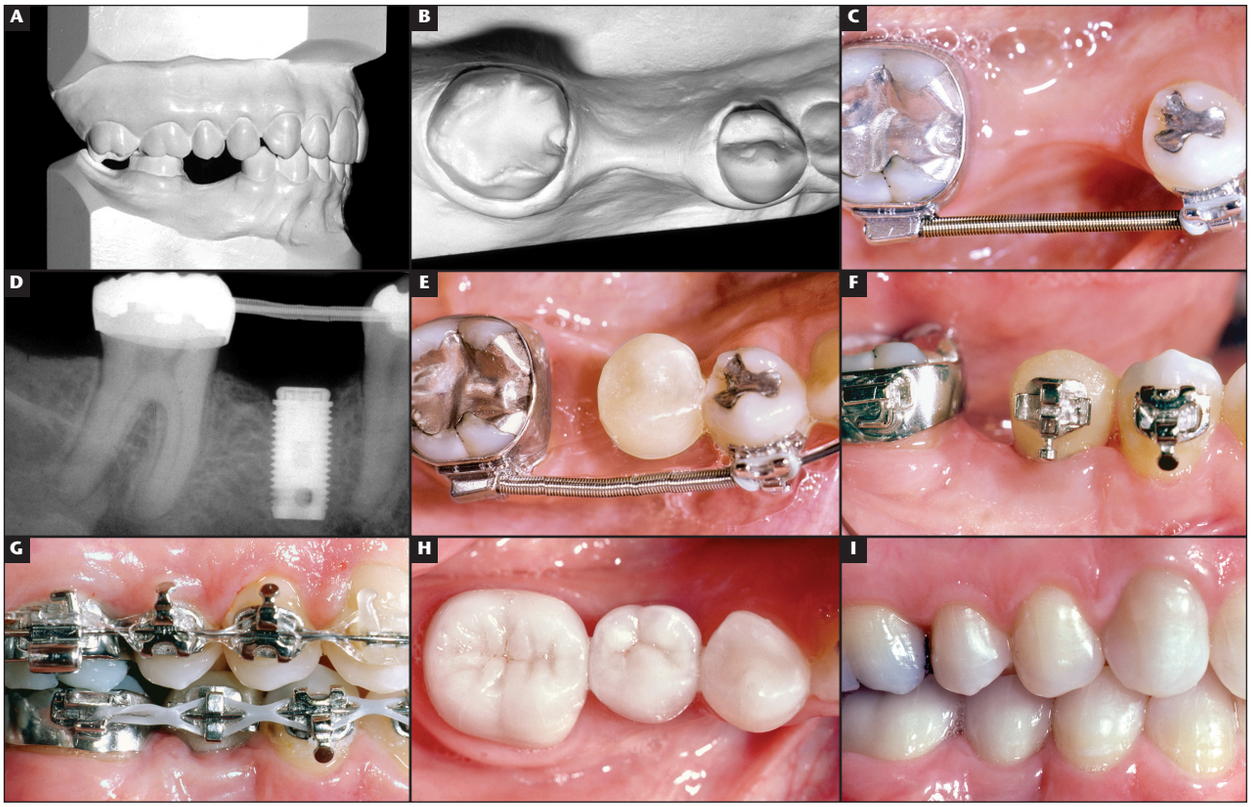

Figure 3 This adult female was missing the mandibular right second premolar and permanent first molar (A). As a result, there was too much space for one-tooth replacement and too little space for two-teeth replacement (B,C). An implant was placed in the first premolar position (D). It was restored (E) and a bracket was placed on the implant provisional crown (F). The implant was used to close the remaining edentulous spaced (G). The width of the final premolar crown was normal size (H) and an Angle Class I occlusion was achieved (I).

...If some drifting of the adjacent teeth has occurred, the resulting edentulous space may be too large for one-tooth replacement, and too small for two-teeth replacement. In these situations, it could be advantageous to place a single-tooth implant in the appropriate position prior to the orthodontic treatment.

Occasionally the decision to extract an ankylosed and submerged primary second molar will be made too late, resulting in a narrow alveolar ridge with a vertical defect. If an implant will be placed in this site, a bone graft may be necessary to provide adequate ridge width and height. However, another possibility exists, especially if the patient will be undergoing orthodontic therapy. It may be advantageous to push the first premolar into the second premolar position, thereby creating space for the single-tooth implant in the first premolar location. When faced with this decision, clinicians are often fearful that there is insufficient alveolar ridge width in which to move the permanent first premolar. However, previous studies[12,13] have shown that a wider tooth root can be pushed through a narrow alveolar ridge without compromising the eventual bone support around the repositioned tooth root. We have performed this type of tooth movement on several occasions resulting in a much better ridge in which to place the implant.

Another possible situation is the patient who is missing not only the second premolar, but also the first permanent molar (Figure 3). If some drifting of the adjacent teeth has occurred, the resulting edentulous space may be too large for one-tooth replacement, and too small for two-teeth replacement. In these situations, it could be advantageous to place a single-tooth implant in the appropriate position prior to the orthodontic treatment. This implant can be restored and used as an anchor to close any excess and remaining space, using the implant as an anchor to avoid unwanted occlusal changes in the remaining dentition.[14] The advantage to the patient is a reduction in the number of restorations required to fill the edentulous space. The advantage to the orthodontist is having an immobile anchor in the bone to protract or retract the adjacent teeth to close the space. This type of interdisciplinary treatment requires proper planning, the construction of a diagnostic wax-up, and precise positioning of the implant to satisfy the

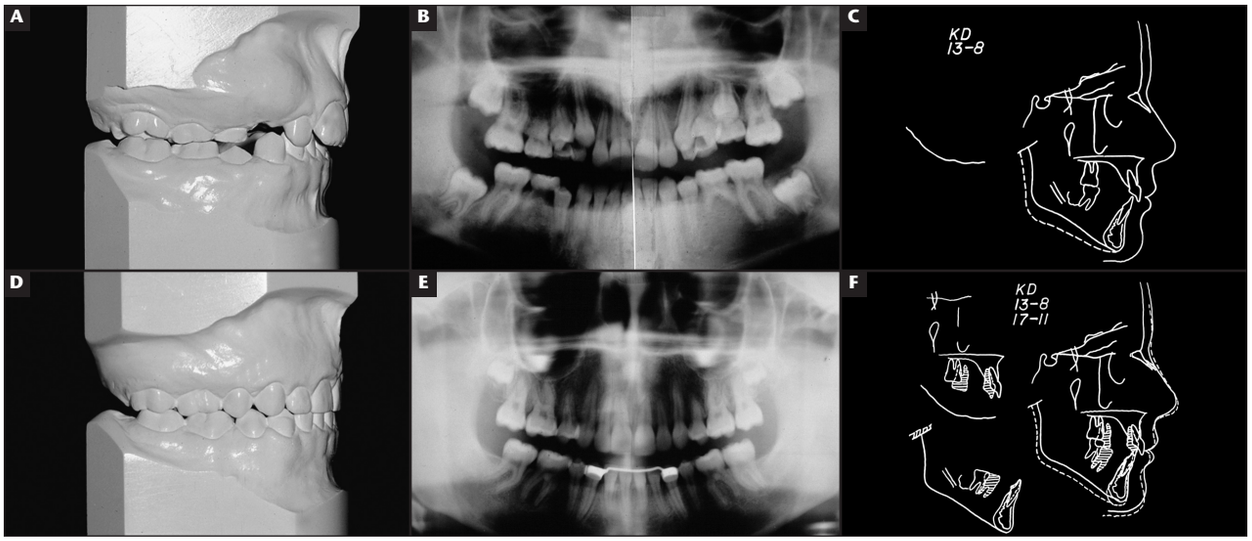

Figure 4 This adolescent female had an end-to-end malocclusion (A) and was congenitally missing three second premolars (B). Her facial profile was ideal. In order to avoid any future restorations and prevent any negative facial changes, a chin cup and elastics were used to protract the maxillary and mandibular molars into a class I relationship (D). This significant tooth movement eliminated the need for extensive restorative dentistry (E), without jeopardizing her facial profile (F).

orthodontic, surgical, and restorative objectives (Figure 3).

If an implant is used to move adjacent teeth and close an edentulous space, the timing of implant loading is an important factor. In the past, implant loading traditionally has been delayed until the implant had fully integrated with the surrounding bone.[15] However, recent studies have shown that early or immediate loading is possible,[16,17] especially in the orthodontic patient.[18] The difference is that an orthodontic load is continuous and in one direction, whereas an occlusal load is intermittent and in different directions. Researchers have shown that a continuous load in the same direction actually stimulates bone formation, which further enhances the osseointegration of the implant. So, in most orthodontic situations, implants may be loaded early, soon after the restorative dentist has placed the temporary restoration.

Another alternative for treating the patient who is congenitally missing the mandibular second premolars is to simply close the space.[19] If the patient has crowding in the opposite dental arch, or a protrusive facial profile, closure of the edentulous space would be advantageous. However, in the patient with no dental crowding and a normal facial profile, closure of the edentulous space from a congenitally missing second premolar could produce an undesirable facial profile. In these situations, the orthodontist requires additional anchorage, either extraoral or intraoral, to avoid these unwanted facial changes. A protraction facemask or a chin cup (Figure 4) are two examples of extraoral appliances that will accomplish this type of tooth movement. Miniscrews[20] and mini-implants are an intraoral method of providing additional anchorage to close these edentulous spaces without altering the patient's facial profile. Another method of closing the edentulous space is to hemisect the primary second molar at an early age,[21,22] and allow the permanent molar to erupt in a mesial direction without affecting the position of the mandibular incisors. If the orthodontist can see the patient at an early age and monitor the patient on a regular basis, this alternative is especially attractive.

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Case Presentation 1

This 12-year, 4-month-old female was congenitally missing the mandibular right second premolar. The right primary second molar was present, but was submerged below the occlusal levels of the adjacent teeth (Figure 1A). The radiograph of the primary tooth shows that the bone levels between the primary molar and the adjacent permanent teeth are flat (Figure 1B). This indicates that the primary tooth was not ankylosed and had erupted evenly with the adjacent teeth. The mesiodistal width of the primary molar was 13 mm (Figure 1C),

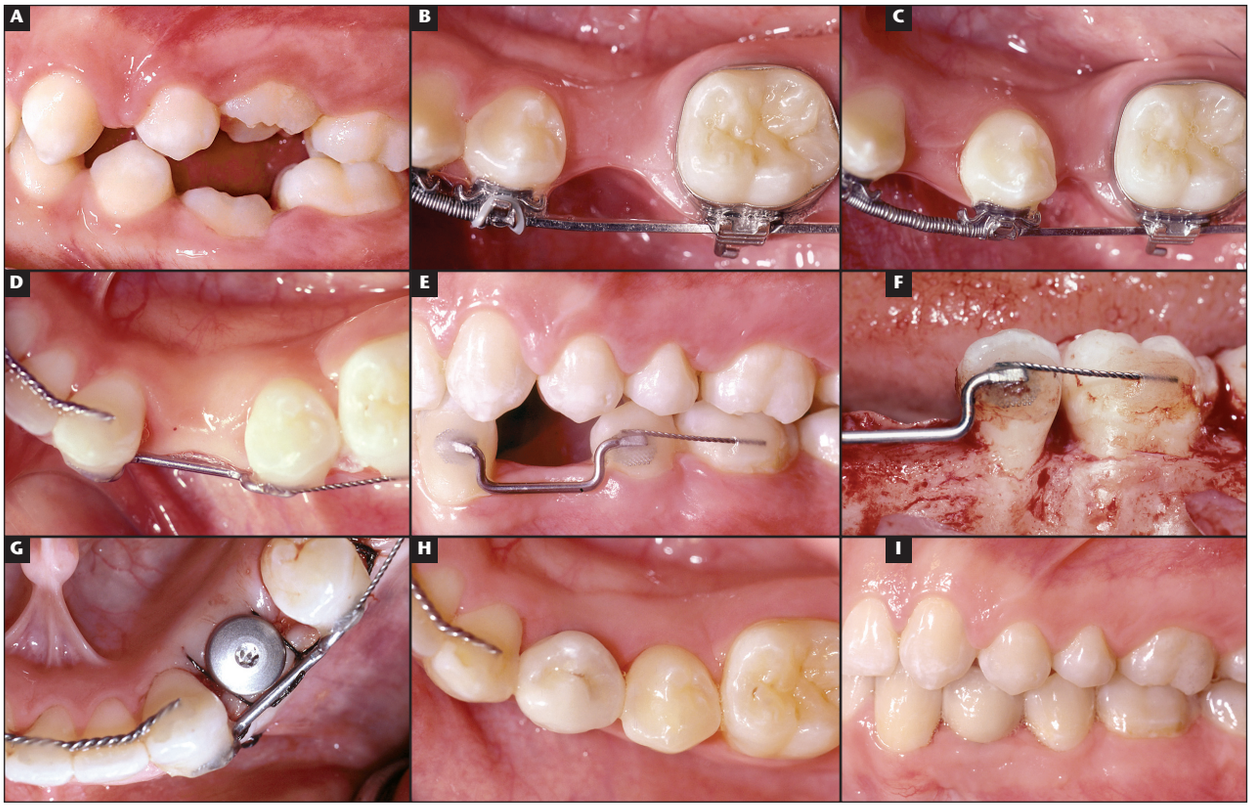

Figure 5 This late adolescent female was congenitally missing her mandibular left second premolar and the primary molar was ankylosed and submerged (A). The primary molar was extracted, which resulted in a significant narrowing of the edentulous ridge (B). The first premolar was pushed distally (C,D,E) into the second premolar position. This orthodontic movement allowed an implant to be placed in the newly regenerated bone (F,G). After restoration of the first premolar implant in the second premolar position (H), it is difficult to recognize any difference (I).

while the normal width of an average mandibular second premolar is 7.5 mm. Although a single-tooth implant was the planned replacement for the missing premolar, the patient was too young and still growing. In order to preserve the buccolingual bone for an eventual implant, the primary molar was reduced in width (Figure 1D and Figure 1E), restored with composite (Figure 1F and Figure 1G), and the remaining space was closed in order to produce class I molar and canine relationships after orthodontic therapy (Figure 1H and Figure 1I).

Case Presentation 2

This young girl was 8 years, 3 months of age and had bilateral, submerged mandibular primary second molars (Figure 2A). The radiograph (Figure 2B) showed that the bone levels between the right primary second molar and adjacent permanent first molar were angled or oblique, indicating that the permanent tooth had continued to erupt. All remaining primary teeth were extracted, no space maintaining appliances were placed, and the remaining permanent teeth were allowed to erupt (Figure 2C). Even though a significant vertical bony defect remained immediately after extraction of the submerged primary molar, subsequent tooth eruption normal level (Figure 2D) and eliminated the alveolar defect. Since the position of the mandibular incisors was located so far to the lingual (Figure 2E), the mandibular incisors were proclined labially, and space was opened between the premolar and molar (Figure 2F) for the placement of a single-tooth implant (Figure 2G). This implant was restored with a second premolar crown (Figure 2H), which helped to re-establish proper occlusion for the patient. The bone to house the implant was created through orthodontic implant site-development.

Case Presentation 3

This adult female was missing her mandibular right second premolar and first molar. The mandibular second molar was in an Angle Class II relationship with the maxillary first molar (Figure 3A), and the edentulous space between the second molar and first premolar (Figure 3B), was too large for one tooth and too small for two teeth. After initial orthodontic alignment (Figure 3C), a diagnostic wax-up was constructed to determine the precise position for a second premolar implant (Figure 3D). After integration of the implant, a provisional crown was attached (Figure 3E), and a bracket was placed on the implant-supported crown (Figure 3F). The implant was used as an anchor to move the mandibular right second molar mesially into an Angle Class I relationship, without jeopardizing orthodontic anchorage, the position of the remaining anterior teeth (Figure 3G), or the patient's facial profile. The final porcelain crown on the implant (Figure 3H) was the appropriate size, and the eventual posttreatment occlusion was finished in an ideal Angle Class I relationship (Figure 3I). Using the implant as an anchor for partial closure of a two-tooth space minimized the

complexity of the orthodontics and the restorative management of this patient.

Case Presentation 4

This 13-year, 8-month-old patient had an Angle Class II occlusion bilaterally, with a 5-mm anterior overjet (Figure 4A). She had a minor arch length deficiency in both arches, but was congenitally missing the maxillary right, and mandibular right and left permanent second premolars (Figure 4B). Her maxilla and mandible were well related (Figure 4C), and the maxillary and mandibular incisors were in a relatively normal anteroposterior position. Extraction of the maxillary left second premolar and remaining primary second molars and closure of all edentulous spaces would have been detrimental to her facial profile by overly retracting the lips relative to the chin. The only options for avoiding the incisor retraction would have been placement of mini-implants for anchorage to protract the maxillary and mandibular first molars, or extraoral anchorage to achieve the same objective. Since this patient was treated prior to the era of mini-implants, a chincup and elastics were used to slide the maxillary and mandibular first molars mesially along a continuous archwire. The posttreatment dental casts (Figure 4D) show that an Angle Class I molar relationship was achieved. The intraoral radiograph (Figure 4E) shows the amount of tooth movement that occurred, and the cephalometric superimposition before and after orthodontics (Figure 4F) provides verification that the mandibular incisors did not move lingually, but that the mandibular molars moved entirely mesially using the protraction force. Although this tooth movement required 4 years of orthodontic treatment, the patient has no restorations, and the facial profile has been maintained in spite of the three congenitally missing premolars.

Case Presentation 5

This 14-year, 6-month-old female was congenitally missing her mandibular left second premolar (Figure 5A), and the primary second molar was ankylosed and submerged. The maxillary left second premolar was present but delayed in its eruption. After extraction of the primary second molar, substantial bone resorption with significant vertical and buccolingual narrowing of the alveolar ridge had occurred (Figure 5B). This degree of ridge defect would probably narrow even further and require a bone graft prior to implant replacement. However, another approach involved moving the first premolar into the second premolar position (Figure 5C through Figure 5E), which created adequate ridge for the first premolar implant. When the flap was elevated to place the implant, sufficient alveolar bone was located distal to the premolar where the ridge had been deficient (Figure 5F). By using the adjacent tooth as the stimulus for alveolar site development, no bone graft was necessary, when the implant was placed (Figure 5G). The final crown on the mandibular implant provides the proper space and support for the occlusion, and the first premolar functions nicely in the second premolar position.

Summary

This article has described and illustrated several methods of managing the patient who is congenitally missing mandibular second premolars. In the past, orthodontists primarily made the treatment decisions in these types of patients. However, with the addition of newer solutions to restoring edentulous spaces, surgeons and restorative dentists may play a significant role in helping to manage these types of orthodontic patients. Although the orthodontist may see these patients at a young age, some of the decisions that are made at that time will affect the patient for a lifetime. This article has emphasized the interdisciplinary aspects of treating a patient who is congenitally missing their mandibular second premolars, in order to provide the patient with the best possible result that teamwork dentistry can offer.

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1. **If space will be left open for an eventual restoration, the keys during orthodontic treatment are to:**
   a. create the correct amount of space.
   b. leave the alveolar ridge in an ideal condition to receive a restoration in the future.
   c. straighten the remaining teeth until an implant can be placed.
   d. a and b

2. **Which of the following can result in devitalization of the pulp in young patients?**
   a. root canal therapy
   b. full-coverage conventional bridges
   c. amalgam restorations
   d. conventional orthodontics

3. **Ostler and Kokich evaluated the long-term changes in the width of the alveolar ridge after extraction of the mandibular primary second molars. Their data showed that the ridge:**
   a. widens by 20% during the first 3 years after primary tooth extraction.
   b. narrows by 20% during the first 3 years after primary tooth extraction.
   c. widens by 25% during the first 4 years after primary tooth extraction.
   d. narrows by 25% during the first 4 years after primary tooth extraction.

4. **After 7 years, the ridge:**
   a. widens by another 5%.
   b. narrows by another 5%.
   c. widens by another 10%.
   d. narrows by another 5%.

5. **The appropriate age for implant placement is determined by the cessation of:**
   a. primary tooth eruption.
   b. vertical facial growth.
   c. horizontal facial growth.
   d. secondary tooth eruption.

6. **Fudalej and coworkers have shown that, on average, females continue facial growth until about:**
   a. 16 years of age.
   b. 17 years of age.
   c. 18 years of age.
   d. 19 years of age.

7. **The same researchers have shown that, on average, males continue facial growth until about:**
   a. 18 years of age.
   b. 19 years of age.
   c. 20 years of age.
   d. 21 years of age.

8. **Primary molars are too wide:**
   a. mesiodistally.
   b. mesioocclusally.
   c. distalocclusally.
   d. distal-lingually.

9. **A guide to estimating the correct amount of reduction is to measure the mesiodistal width of the primary molar at the level of the:**
   a. adjacent teeth.
   b. cementoenamel junction.
   c. the gingiva.
   d. crown of the root.

10. **The most reliable indicator of primary molar ankylosis is to evaluate the alveolar bone levels between the:**
    a. secondary molar and adjacent molar and first premolar.
    b. crown of the molar and the gingiva.
    c. primary molar and the adjacent permanent first molar and first premolar.
    d. primary molar and the adjacent canine.

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