Management of congenitally missing second premolars with orthodontics and single-tooth implants

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This article describes the treatment of an adolescent girl who was congenitally missing all 4 second premolars and had a retained mandibular second primary molar. Various treatment alternatives are discussed, and the final treatment plan of space opening for 3 implants and space closure of the maxillary left second premolar site is presented. (Am J Orthod Dentofacial Orthop 2004;125:634-42)

Congenital absence of teeth is a common dental anomaly. The frequency of missing teeth varies with the population investigated, but several studies have suggested that, excluding third molars, the second premolar is the most common congenitally absent tooth.1-3 Often this anomaly is associated with retained and infraoccluded primary molars and with clinical sequelae, such as reduced alveolar height, supraeruption of opposing teeth, tipping of first molars with space loss, and, in some cases, impaction of the first premolar.4 This clinical situation is a challenge to pediatric dentists, prosthodontists, and orthodontists. The orthodontic literature is replete with articles and case reports on missing maxillary lateral incisors; the orthodontic management of patients with missing second premolars is not as well documented. The purpose of this case report is to describe the various treatment alternatives and the management of an adolescent patient with missing second premolars and a retained mandibular primary molar.

HISTORY

An adolescent girl, aged 16 years, came for orthodontic evaluation with spaces between her back teeth. Her referring dentist told her she had a “bite problem” and that her spaces could not be managed by restorative means. Her dental history included extraction of 3 second deciduous molars at different times; the mandibular left second deciduous molar was still present. The probable cause of her malocclusion was a combination of genetic and developmental factors. A paternal aunt and the aunt’s daughter were also missing teeth.

DIAGNOSIS

The patient had a straight and harmonious profile, with competent lips at rest. From a frontal view, there was a slight vertical excess of the lower third of the face. Upon smiling, between 3 mm (anteriorly) and 4 mm (posteriorly) of gingival display was noted (Fig 1).

Intraorally, she had a Class I molar-Class II canine relationship on the right side and a Class II molar-Class I canine relationship on the left side. The maxillary incisors were lingually inclined, and the overbite was excessive (90%). The mandibular incisors were upright, and a severe curve of Spee was present. The maxillary dental midline deviated slightly to the patient’s left in relation to the facial midline, whereas the mandibular midline deviated to the right, leading to a 3-mm dental midline discrepancy. The retained mandibular left second deciduous molar was in infraocclusion and impinging on the distal marginal ridge of the first premolar, preventing its complete eruption.

The right second premolar was missing, with tipping of the adjacent teeth, leaving 3 mm of residual space. Both maxillary second premolars were also missing, with 7.6 mm of space on the right side and complete space closure on the left side. The maxillary left first premolar was overerupted and rotated into the space. Arch-length deficiency was 5 mm in the maxilla and 3 mm in the mandible, and both arch forms were ovoid. The overall periodontal condition was good, with acceptable oral hygiene, and the dentition was not restored (Figs 2 and 3). Functional assessment showed that mouth opening and excursions were within normal functional limits, with no signs and symptoms of temporomandibular joint dysfunction.
The panoramic radiograph confirmed that the 4 second premolars were congenitally missing, as was the mandibular left third molar. The persistent mandibular left second deciduous molar appeared in infraocclusion, with a horizontal interdental crestal bone level and no root resorption. The roots adjacent to the missing maxillary second premolar sites were parallel, whereas those adjacent to the missing mandibular second premolars were divergent. The overall bone level was within normal limits (Fig 4).

Cephalometric analysis showed a skeletal Class I anteroposterior relationship (ANB angle = 3°), with slight retrusion of both maxilla and mandible relative to the cranial base. The facial pattern was dolichocephalic, as evidenced by a Frankfort-mandibular plane angle of 31°. Despite uprighted maxillary and mandibular incisors, soft tissue analysis showed a normal relationship to the Holdaway line of the chin, lips, and nose (Fig 5, Table).

**TREATMENT OBJECTIVES**

The main objective in the treatment of this patient was to address the missing second premolars, either by
space closure or by space opening and restorative treatment, without adversely affecting the profile. Maxillary and mandibular incisors were to be intruded and proclined to an optimal overbite-overjet relationship. The gingival smile was to be reduced. The Class II canine relationship on the right side needed correction, along with the dental midline discrepancy.

**TREATMENT ALTERNATIVES**

A surgical approach was considered but dismissed. The reason for consideration was to address the gingival smile. It was dismissed because it was not a concern of the patient, who did not consider her gingival smile distracting. Besides being unjustified as a treatment objective, the surgical approach would not have had a

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**Fig 3.** Pretreatment dental casts.

**Fig 4.** Pretreatment panoramic radiograph.

**Fig 5.** Pretreatment cephalometric tracing.
positive outcome on the face (it would have widened the nose).

The 2 basic orthodontic options that were considered seriously were space closure or space opening:

1. Close all missing second premolar spaces after extracting the retained primary molar. The main advantage of this treatment option is that it would obviate the need for restorations. Nevertheless, with uprighted incisors initially, the risk of adversely affecting the profile made this treatment alternative undesirable. Furthermore, space closure would not facilitate overbite correction. To minimize profile changes, closing the maxillary second premolar spaces only and finishing in Class II molar-Class I canine relationship could have been considered; but even though the maxillary left second premolar space was already closed, the 7.6-mm space to be closed on the right side would still make overbite and maxillary incisor torque control difficult.

2. Open all missing second premolar spaces except the maxillary left second premolar site, which was closed initially, and finish in molar Class I relationship on the right and Class II on the left. The restorative option to replace the 3 missing premolars would be single-tooth implants, thus avoiding any preparation of adjacent teeth. The retained second deciduous molar could have been maintained; some reports indicate a good prognosis for long-term survival. However, this would lead to a compromised occlusion on the left side (“super Class II”), because the primary molar occupies a larger mesiobuccal-distal space than the replacing premolar. Maintaining a primary second molar, which is considered a semipermanent solution, in a patient who is to receive implants anyway, was therefore unjustified.

The second option was adopted. The molars were already in a Class I right and Class II left relationship. Initial root parallelism and divergence adjacent to the missing second premolar sites were also in favor of space opening and implant placement. The moderate arch deficiency would be resolved by proclining anterior teeth while opening adequate mandibular and maxillary right second premolar spaces.

### Table. Cephalometric summary

<table>
<thead>
<tr>
<th>Measurement</th>
<th>Norm</th>
<th>Before treatment</th>
<th>After treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Skeletal</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SNA (°)</td>
<td>82</td>
<td>78</td>
<td>79</td>
</tr>
<tr>
<td>SNB (°)</td>
<td>80</td>
<td>75</td>
<td>76</td>
</tr>
<tr>
<td>ANB (°)</td>
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<td>3</td>
<td>3</td>
</tr>
<tr>
<td>FH-NA (°) (maxillary depth)</td>
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<td>84</td>
<td>86</td>
</tr>
<tr>
<td>FH-NP (°) (facial angle)</td>
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<td>82</td>
<td>83</td>
</tr>
<tr>
<td>Wits (mm)</td>
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<td>−1</td>
<td>3</td>
</tr>
<tr>
<td>SN-MA (°)</td>
<td>32</td>
<td>36</td>
<td>36</td>
</tr>
<tr>
<td>FMA (°)</td>
<td>25</td>
<td>31</td>
<td>30</td>
</tr>
</tbody>
</table>

| Dental                       |      |                 |                 |
| U1-SN (°)                    | 103  | 90              | 102             |
| U1-NA (°)                    | 22   | 11              | 22              |
| U1-NA (mm)                   | 4    | 3               | 4               |
| L1-NB (°)                    | 25   | 19              | 25              |
| L1-NB (mm)                   | 4    | 5               | 6               |
| L1-MP (°)                    | 87   | 88              | 93              |
| L1-Apo (mm)                  | 1    | 2               | 3               |
| U1-L1 (°)                    | 131  | 147             | 129             |

| Soft tissue (mm)             |      |                 |                 |
| Tip of nose                  | 9    | 9               | 8               |
| Subnasal                     | 5    | 5               | 5               |
| Upper lip                    | 0    | 0               | 0               |
| Lower lip                    | 0    | −1             | −1              |
| Supramentale                 | 5    | 5               | 5               |
| Pogonion                     | 0    | 0               | 0               |

The second option was adopted. The molars were already in a Class I right and Class II left relationship. Initial root parallelism and divergence adjacent to the missing second premolar sites were also in favor of space opening and implant placement. The moderate arch deficiency would be resolved by proclining anterior teeth while opening adequate mandibular and maxillary right second premolar spaces.

### TREATMENT PROGRESS

After caries control and oral hygiene instruction, the mandibular left second primary molar was extracted carefully to prevent bone loss in the future implant site due to possible ankylosis. Orthodontic treatment was started in the maxillary arch to avoid mandibular bracket interference with the lingually inclined maxillary anterior teeth. The first molars and the left first premolar were banded to facilitate correction of the rotation with lingual attachments. Edgewise brackets (.022 × .028 in) were bonded on the remaining maxillary teeth, excluding the second molars. The maxillary arch was leveled and aligned, and the incisors were intruded and proclined with a progression of archwires, starting with a .016-in Nitinol (3M Unitek, Monrovia, Calif) and working up to .018-in, heat-treated stainless steel wires. The mandibular arch was banded and bonded 5 months into treatment, and the teeth were leveled and aligned. A maxillary removable anterior biteplane was used for 6 months to avoid bracket interference and to help correct the overbite and intrude the mandibular anterior teeth. Equal second premolar spaces of 7.4 mm each in the mandible and 7 mm in the maxilla were created with compressed coils on .018-in stainless steel wires (Fig 6). Class II elastics were used on the right side for 12 months, to bring the right canines into a Class I relationship and help correct the midline discrepancy. Nobel Biocare (Gothenburg, Sweden) implants, 10 × 4 mm in the maxilla and 11.5 × 4 mm each in the mandible, were placed 2 years 9 month into treatment, at 18 years 9 month of age, after a progress panoramic radiograph showed proper root parallelism (Fig 7). Pretreatment and progress cephalo-
metric superimpositions also showed cessation of growth (Fig 8). The appliances were removed 3 years 5 months after the initiation of treatment, and the implants were loaded with temporary crowns on the same day. Impressions were made for a maxillary Hawley retainer to be worn full time for 12 months, followed by 6 months of nighttime wear. The mandibular retainer consisted of a .0215-in twist wire bonded onto the lingual side of the incisors and the canines. The lingual retainer could be kept permanently to enhance the long-term stability of the results. Final crowns were placed 7 months after debanding.

TREATMENT RESULTS

Favorable facial changes were observed. The profile was not adversely affected with treatment. There was a net improvement of the gingival smile (Fig 9). Intraorally, dental esthetics were enhanced, with proclination of anterior teeth. The deepbite was resolved, and optimal overbite and overjet relationships were achieved. Dental midlines were corrected and coincided with the facial midline. The arch-length deficiency was eliminated in both arches, and excellent alignment was obtained. A well-interdigitated buccal occlusion was established, with a Class I canine and a Class II left-Class I right molar relationship. There was canine guidance in lateral excursions, without balancing interferences. Both arch forms were ovoid and coordinated, and the second premolar crowns on the implants appeared well-integrated in terms of size, shape, and color (Figs 10 and 11).

The posttreatment panoramic radiograph showed good overall root parallelism. The 3 implants were centered, with good osseointegration and proper crown fit. Supporting tissues appeared healthy, and no signs of root resorption were seen despite the lengthy treatment time. The maxillary third molar buds were high, and the roots were not developed. The mandibular right third molar bud was mesially tipped (Fig 12).

The posttreatment cephalometric radiograph and superimposed tracings showed no changes in the skeletal measurements after treatment, as expected, with no orthopedic treatment and minor growth activity. The maxillary and mandibular incisors were proclined to normal relationships. Soft tissue analysis showed some advancement of the upper and lower lips, along with some late growth of the nose. This has maintained a
normal relationship to the Holdaway line of the chin, lips, and nose (Figs 13 and 14, Table).

DISCUSSION

The 2 treatment options commonly used with congenitally missing second premolars are space opening for future restorations or space closure so that natural teeth touch each other. Space closure is definitely a more attractive solution in adolescent patients because of the permanence of the finished result. The need to maintain space until the end of growth for a permanent restoration is also avoided. However, treatment decisions should depend on the basic orthodontic diagnosis. Arch-length deficiency, facial profile, and the existing malocclusion must all be evaluated. Second premolar extractions are traditionally prescribed for borderline tooth-size and arch-length discrepancies in which incisors are upright over basal bone. Therefore, space closure for the missing second premolars could have been justified for this patient. Nevertheless, congenitally absent teeth should not influence us or tip the balance toward extraction treatment and the attractive

Fig 9. Posttreatment facial photographs.

Fig 10. Posttreatment intraoral photographs.
solution of space closure when nonextraction treatment is indicated. Treatment results have shown that this patient benefited from the nonextraction and space-opening treatment option. Space closure would have been disadvantageous considering her initial uprighted incisors, overbite, normal profile, and lack of severe arch-length deficiency.

With space opening, various replacement options for the congenitally missing second premolars are available. Since the advent of implants, the osseointegrated single-tooth implant is becoming the treatment of choice. Other replacement options are fixed bridges. The conventional bridge and the inlay-onlay abutment type of restoration are no longer primary indications in young patients with noncarious or non-

Fig 11. Posttreatment dental casts.

Fig 12. Posttreatment panoramic radiograph.

Fig 13. Posttreatment cephalometric tracing.
restored adjacent teeth. The resin-bonded bridges (Maryland type) are also inappropriate because of a high failure rate, as shown by long-term studies.8,9 Autotransplantation of the 3 existing molar buds in the missing second premolar sites could have been a replacement option for this patient. Although reported in the literature, the size and shape of third molars would have been inappropriate, leading to a compromised occlusion.10

Currently, osseointegrated implants are becoming the most biologically conservative and most indicated option for replacing congenitally missing single teeth.11-16 Therefore, it is the orthodontist’s responsibility to prepare the future implant site throughout the mixed dentition. Besides managing the vertical and mesiodistal tooth position with proper root parallelism, the task of the orthodontist is to provide adequate bone height and width (labioluminally) to permit optimal implant placement. Preventing space and alveolar bone loss is important, and the second deciduous molar can be an ideal space maintainer.17 If not ankylosed, second deciduous molars can remain in place to preserve bone height and width. Because they are larger than the succedaneous premolars, reduction of their mesiodistal width to approximately 7.0 mm is recommended.15 However, crown width reduction of mandibular second primary molars could be limited by root divergence. In the case of infraocclusion, a composite buildup is indicated to prevent supracorona of opposing teeth and possible tipping of the first permanent molar.

Ankylosis of deciduous molars is often associated with congenitally missing second premolars.4,17 If ankylosis develops at an early age, and the ankylosed primary molar is left in position, alveolar bone will not develop vertically with adjacent teeth during growth. Delayed extraction of ankylosed deciduous molars, after orthodontic treatment, will lead to a severe vertical bone defect, making implant placement extremely difficult, and will likely make a bone graft necessary.18 Extraction timing of ankylosed deciduous molars is therefore critical and depends on the patient’s age and the amount of growth remaining.15 Research has shown that, after extracting a deciduous molar in a growing patient, the alveolar ridge will move occlusally with the adjacent teeth by stretching of the periosteum over the edentulous ridge.19 Deciduous molars were probably extracted in this patient at different times as ankylosis was diagnosed. These early extractions prevented vertical crestal bone deficiencies. If an ankylosed molar is not extracted early enough and a vertical ridge defect is produced, movement of the mandibular first premolar into the second premolar position has been suggested as an alternative to bone grafting.15,18 Another approach to avoid bone deficiency is early extraction of the primary first molar, when half of the root of the succedaneous premolar has developed. This will favor eruption of the first premolar into the second premolar site, simulating alveolar ridge development.20

Early extraction of a submerging second deciduous molar is generally preferable to late extraction. Even with spontaneous space closure after extraction, subsequent orthodontic treatment, with either space opening or space closure, will not be more complex.21 As seen in this case report, later space reopening after early extraction of deciduous molars will lead to bone suitable for proper implant placement.19

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REFERENCES