

# Early Management of Congenitally Missing Teeth

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Often children and adolescents are congenitally missing their maxillary lateral incisors or mandibular second premolars, and frequently it is the orthodontist who diagnoses the agenesis. In fact, early orthodontic intervention may eliminate some of the periodontal and restorative problems that could arise in these patients as adults. An excellent implant site can be developed in the mixed dentition by extracting the maxillary primary lateral incisor and guiding the eruption of the permanent canine into the lateral incisor space. Occasionally, the mandibular primary second molar also may require extraction during early adolescence. This is due to ankylosis, which could become a significant periodontal concern, if not addressed early. When there is no permanent successor, an ankylosed primary molar may need to be extracted so the alveolus will develop vertically as the patient grows. Therefore, the orthodontist plays a key role in monitoring eruption and growth of these patients at an early age. If this were done, the final result could be esthetic and predictable. This article will discuss the importance of early diagnosis and intervention in order to preserve various treatment options in the future.

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## Maxillary Lateral Incisors

The maxillary lateral incisor is one of the most common congenitally absent teeth. Two treatment options for patients with missing laterals are opening space or closing space. Today implants have become the restoration of choice, when the treatment plan is to open space. Since implants cannot be placed until facial growth is complete, monitoring eruption, implant site development, and retention are important at an early age. This raises several interesting questions: What can be done in the mixed dentition to develop a future implant site? How much space is necessary? How will the gingival architecture be affected in the area of the missing tooth? These are concerns that the orthodontist must address when planning treatment for these patients in the mixed dentition.

### What Can Be Done in the Mixed Dentition to Develop a Future Implant Site?

As orthodontists, we evaluate patients with missing teeth at an early age. This allows us to monitor and guide eruption through selective primary tooth extraction. Frequently, these 8- to 9-year-old children have retained maxillary primary lateral incisors. Evaluation of periapical or panoramic radio-

graphs may reveal that the crown of the developing permanent canine is positioned apical to the root of the primary canine. Is early orthodontic treatment necessary? If an implant restoration will replace the missing lateral incisor, the faciolingual thickness of the alveolus must be adequate. The alveolar ridge thickness may be influenced by the eruption of the permanent canine. Therefore, the orthodontist should encourage the canine to erupt adjacent to the permanent central incisor (Fig 1A and B).<sup>1</sup> This may involve selective extraction of a retained primary lateral incisor. As the permanent canine erupts into the edentulous space, it establishes the thickness of the alveolus. As the canine is moved distally, an increased buccolingual alveolar width is established (Fig 2A and B).<sup>2</sup> Occasionally the canine may not erupt adjacent to the central incisor. When this occurs, a bone graft may be necessary to establish the appropriate ridge thickness to place an implant.

### How Much Space Is Necessary?

The orthodontist plays a key role in determining and establishing space requirements for patients with missing maxillary lateral incisors. The question that is often asked is: How much space is necessary for missing lateral incisor restorations? There are three ways to determine the appropriate space for these missing teeth. The first is the golden proportion.<sup>3</sup> This method measures teeth by evaluating a smiling or frontal intraoral photograph in a two-dimensional view. Since the maxillary teeth are positioned in a curved arch, each tooth should be 61.8% wider than the tooth distal to it (Fig

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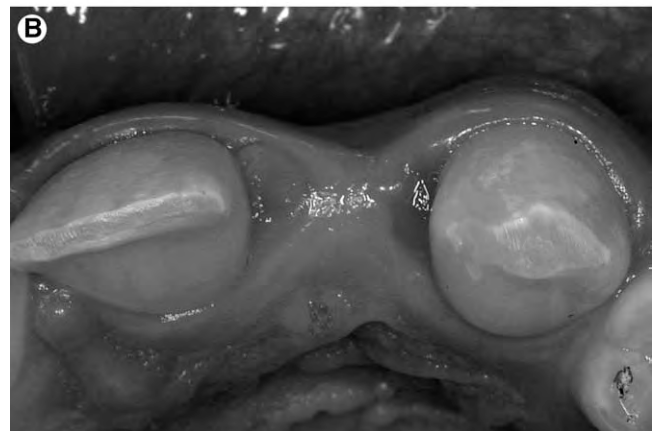
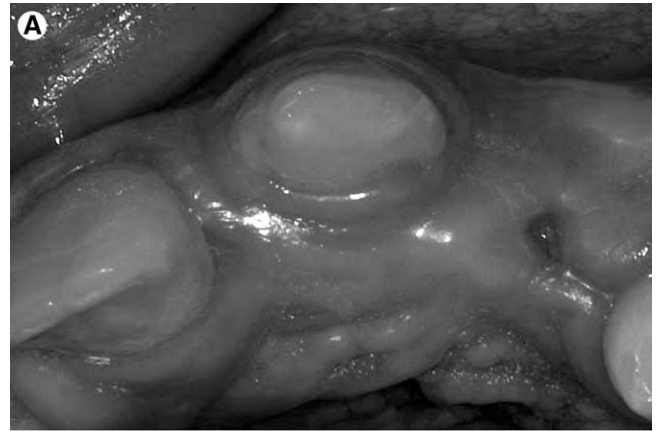
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**Figure 1** (A) Often the primary lateral incisor will be retained in patients with congenitally missing maxillary lateral incisors. (B) The goal is often selective extraction of the retained primary canine to encourage eruption of the permanent canine into the missing lateral incisor position. This will ultimately develop the alveolar ridge for implant placement.

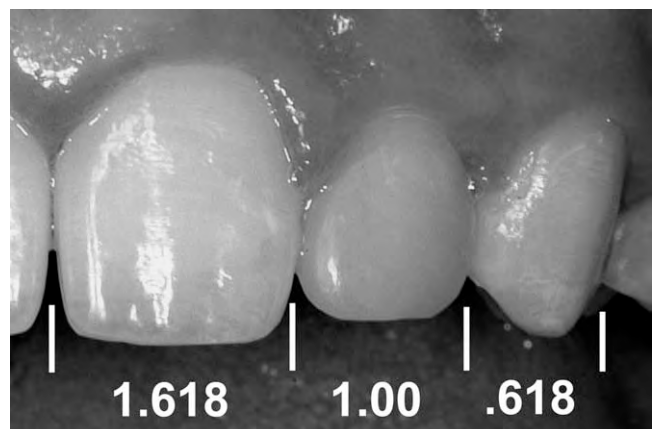
3).<sup>4</sup> For example, a photograph of a maxillary dental arch with an 8-mm-wide central incisor crown should contain a lateral incisor crown width of 5 mm.

The second method to determine the appropriate restorative space is to use the contralateral lateral incisor.<sup>3</sup> If this

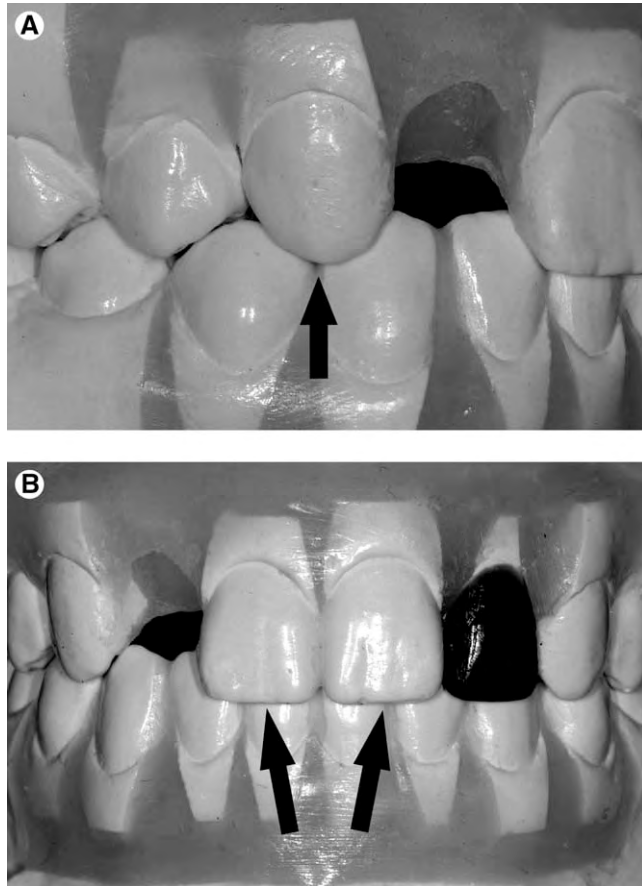


**Figure 2** (A) As the permanent canine erupts adjacent to the central incisor, its large buccolingual width begins to develop the alveolar ridge in the edentulous area. (B) The canine is moved distally, leaving behind an adequate buccolingual width for implant placement.

tooth has a normal width, it can often be used as a guide for the orthodontist to establish ideal spacing for the missing lateral incisor. Unfortunately, this method of space appropri-

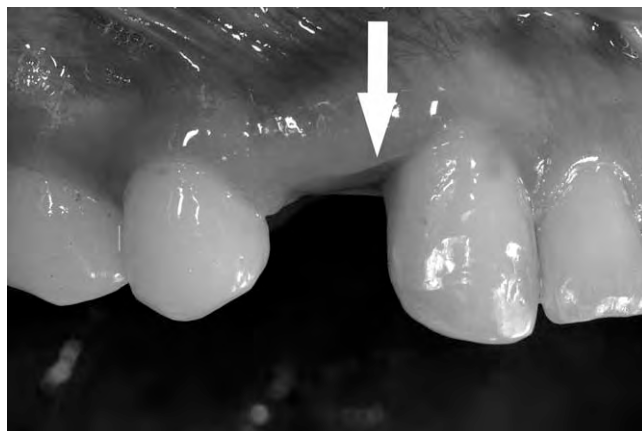


**Figure 3** The “golden proportion” is a two-dimensional measurement of esthetics. It is applied dentally when viewing the arrangement of the maxillary anterior teeth in a frontal photograph. Each tooth, beginning with the central incisor, should be 61.8% larger than the tooth distal to it.

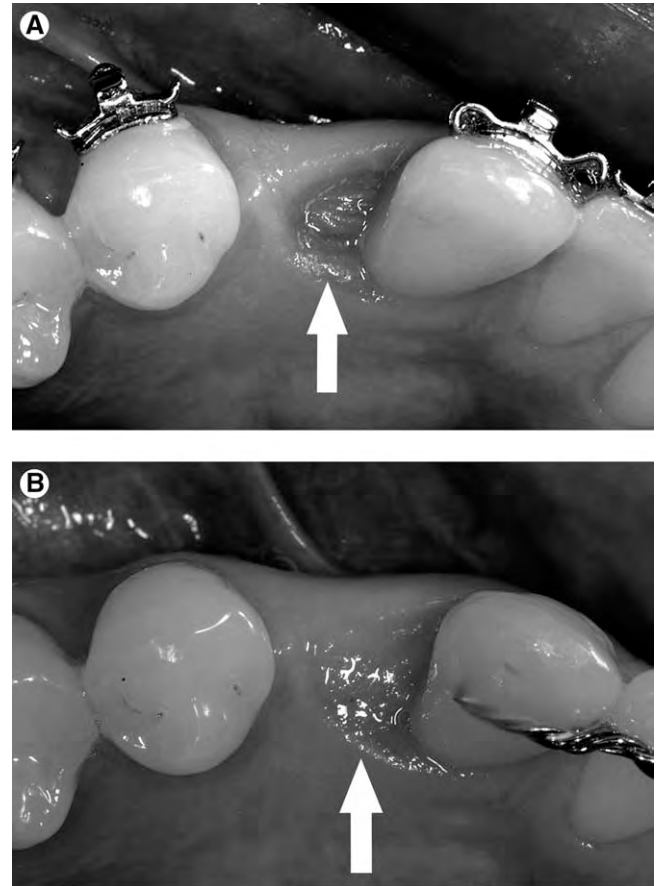


**Figure 4** (A) The maxillary canine should be positioned in the embrasure between the mandibular canine and first premolar. This will allow for proper canine disclusion. (B) The maxillary central incisors should be positioned in the appropriate overbite and inclination to achieve ideal esthetics.

ation is not appropriate for adolescents with missing or peg-shaped contralateral lateral incisors. Therefore, a third method of space appropriation is to conduct a Bolton analysis.<sup>5</sup> Bolton first introduced his ratio in 1958 as a way to compare the mesiodistal widths of the dental arches to



**Figure 5** As the canine is moved mesially in a nongrowing patient, the papilla is left in its original position, mesial to the premolar.



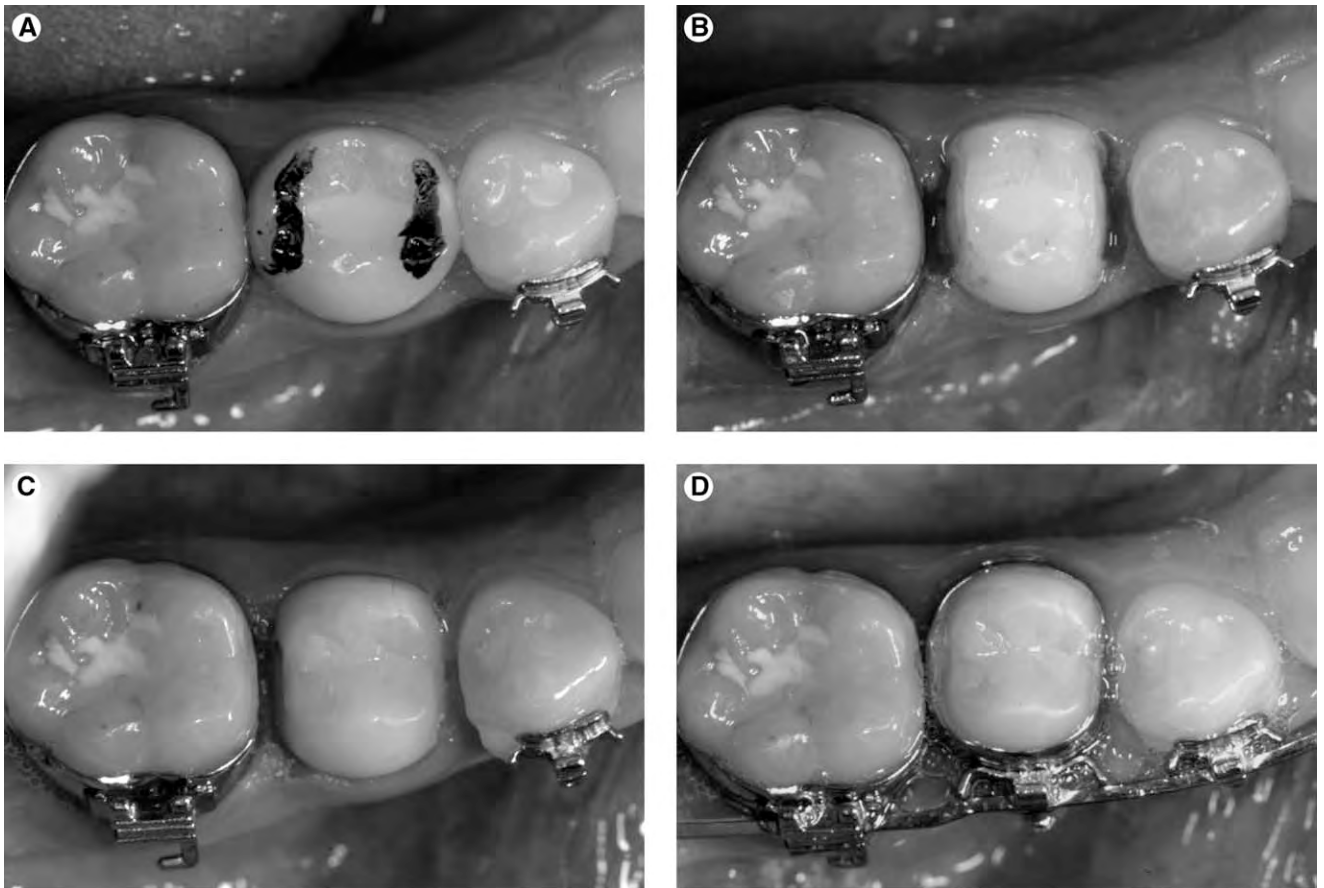
**Figure 6** (A) In this adult patient, the canine was moved mesially, thus everting the sulcus distal to the canine. (B) This red, nonkeratinized, sulcular epithelium gradually keratinizes over time. However, the position of the papilla does not change.

achieve ideal occlusal relationships. His anterior measurement involves dividing the sum of the mesiodistal width of the mandibular six anterior teeth by the sum of the mesiodistal width of the maxillary six anterior teeth. This ratio is approximately 0.78<sup>6</sup> and can be used to mathematically calculate the width of the edentulous spaces for a patient who is congenitally missing one or both maxillary lateral incisors.

The most predictable guide for determining ideal spacing is to construct a diagnostic wax setup. This simplifies treatment for the orthodontist and restorative dentist. Fortunately most adolescents have healthy, nonrestored teeth and do not exhibit significant wear. Therefore, the spacing will be determined ultimately by the occlusion. The canines should be placed in a position that will achieve canine disclusion with the central incisors in a position that will provide optimal esthetics (Fig 4A and B).<sup>3,7,8</sup> The space that remains should be ideal for the lateral incisor restoration. This space is generally 5 to 7 mm.

To select the appropriate restoration for the edentulous space, several diagnostic criteria should be evaluated. The treatment of choice should be the least invasive option that satisfies the esthetic and functional objectives. Single-tooth implants are often the most conservative restoration, because they do not require tooth preparation. However, they should



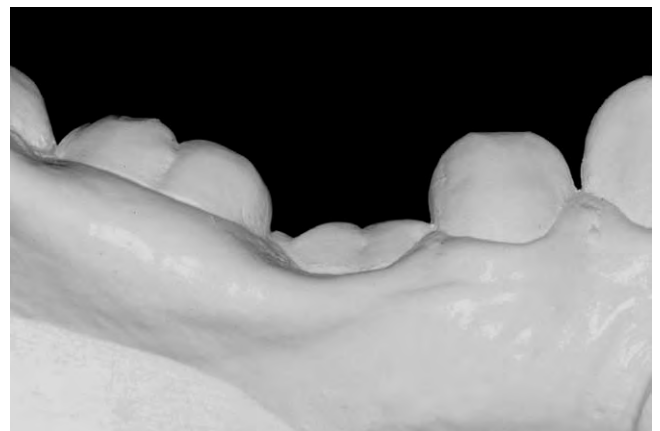


**Figure 7** (A) Before reducing the width of the primary molar, lines can be drawn on the occlusal surface to delineate the appropriate final dimensions. (B) After the mesial and distal surfaces are reduced, the overall width should measure 7.5 to 8.0 mm. This is allowed to heal for 2 to 3 weeks. (C) When the patient returns 2 to 3 weeks later, composite is bonded interproximally and occlusally to recreate an acceptable premolar shape and occlusion. (D) The primary second molar is then banded or bracketed and the residual space is closed.

not be placed until facial growth is complete. Therefore, long-term retention of these edentulous spaces may be necessary. Fixed bridges are less conservative. These tooth-borne restorations include resin bonded, canine cantilever, and full coverage bridges. Selection of the appropriate fixed bridge depends on the position and condition of the abutment teeth.

### How Will the Gingival Architecture Be Affected in the Edentulous Area?

Imagine a patient in the mixed dentition with missing laterals and a wide diastema between the permanent central incisors. The centrals could occupy over half of the natural lateral incisor position. When the centrals are moved mesially, and the diastema is closed, there should be adequate alveolar width for an implant. However, in an adult, this direction of tooth movement will affect papilla heights on the distal of the central incisors as the teeth are moved mesially to close the diastema (Fig 5). According to Atherton, the distal sulcus will be everted as the space is closed leaving the papilla behind.<sup>9</sup> As the nonkeratinized gingiva is exposed, the tissue appears red. Over time this tissue will keratinize, but the location of the papilla does not change (Fig 6A and B). In an adult this could be an esthetic challenge for the periodontist and restor-



**Figure 8** As a patient grows, the teeth continue to erupt to maintain occlusion. However, an ankylosed, primary molar will not erupt. As a result, a significant marginal ridge discrepancy develops between the ankylosed molar and the teeth adjacent to it. If the tooth is not extracted early, the adjacent teeth can begin to tip over the crown of the ankylosed molar, as can be seen in this picture.

ative dentist when placing the implant and designing the restoration. Fortunately, in the mixed dentition as the child's face continues to grow and the teeth erupt, the bone and gingiva constantly change. As a result, the papillae adjacent to the implant site are not affected permanently.

## Mandibular Second Premolars

The mandibular second premolar is another common congenitally missing tooth. An important factor in managing these patients at an early age is space maintenance. Frequently the orthodontist diagnoses the agenesis on a panoramic radiograph. If the patient has no arch length deficiency and will not require extractions to treat the malocclusion, it is important to maintain the primary molar as long as possible. However, the mesiodistal width of the primary second molar creates a mandibular tooth-size excess that makes it difficult for the orthodontist to achieve ideal interdigitation of the posterior teeth. How can the orthodontist achieve an acceptable posterior occlusion and still retain the primary molar for long-term space maintenance? What if the primary molar becomes ankylosed? How should the orthodontist evaluate whether or not the ankylosed tooth requires extraction? These are questions that the orthodontist must answer during dental development to preserve various treatment options in the future.

## How Can the Orthodontist Achieve an Acceptable Posterior Occlusion and Use the Primary Second Molar as a Long-Term Space Maintainer?

It is advantageous to maintain the primary second molar as long as possible to maintain the alveolar bone both vertically and buccolingually. However, it is often difficult for the orthodontist to achieve ideal posterior interdigitation of the occlusion, due to the width of the primary molar.<sup>2</sup> A normal primary second molar is about 9.5 mm wide. Therefore, it may be beneficial to reduce the mesiodistal width so that it approaches the width of a second premolar 7.5 to 8.0 mm.<sup>1,3,10</sup> When determining the extent of tooth reduction, the clinician should evaluate crown width and root divergence on a periapical radiograph. The crown of a primary molar converges significantly toward the cervical region and allows the orthodontist to reduce the crown width by 1.5 to 2.0 mm. However, the extent of reduction may be limited, if the roots diverge significantly.

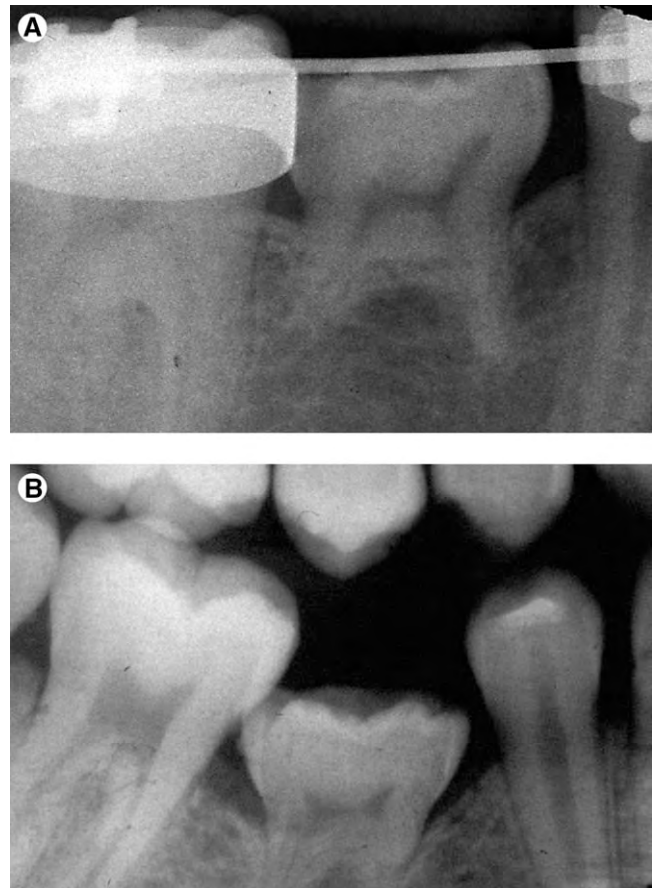
Once the appropriate amount of reduction has been calculated, this information can be drawn on the occlusal surface. A fissure bur in a high speed handpiece is the most efficient way to achieve adequate reduction. Typically patients do not require local anesthesia, because the pulp has undergone significant constriction by age 14 to 15, when the procedure is usually performed.<sup>2</sup> After the tooth reduction has been completed, light-cured composite may be placed interproximally to cover the exposed dentin. It is often necessary to bond composite on the occlusal surface to establish adequate crown height and occlusal contact. Then the ortho-

odontist can bracket the primary molar, close the residual space, and finish the occlusion. The result is an esthetic, functional restoration that will maintain space and alveolar bone support before implant placement (Fig 7A-D).<sup>2</sup>

## When Should an Ankylosed Primary Molar Be Extracted?

Fortunately primary molar ankylosis is a relatively uncommon occurrence, which is often diagnosed during the mixed dentition. As the face grows and the mandibular ramus lengthens, teeth must erupt to remain in occlusion. An ankylosed tooth cannot erupt. As the adjacent teeth continue to erupt, an ankylosed primary molar appears to submerge farther below the level of the occlusal plane (Fig 8).<sup>11,12</sup> This often results in a vertical bony defect between the primary molar and the adjacent permanent teeth, which ultimately may affect implant placement.

It is easy to misdiagnose ankylosis of a primary molar. After all, the crown height of the primary molar is shorter than the adjacent permanent first molar. Therefore, a marginal ridge discrepancy between these teeth does not indicate that the primary molar is ankylosed. Methods of detecting



**Figure 9** (A) A developing vertical, bony defect is becoming visible radiographically as seen on this bitewing radiograph. (B) This young patient exhibits a severe vertical, bony defect. The ankylosed, primary second molar requires extraction in order for the alveolus to continue developing vertically as the patient grows and the adjacent teeth erupt.

ankylosis, such as tapping the tooth to detect a difference in sound, are generally not reliable. The best method of detecting ankylosis is evaluation of interproximal bone levels on a bitewing radiograph. When the bone level is flat, adjacent teeth are erupting at the same rate. However, if a vertical bone defect is visible radiographically, then the primary tooth is ankylosed and may require extraction to avoid a significant vertical ridge defect (Fig 9A and B). The extraction can be a difficult procedure, which often requires a flap and bone removal. The result may be a narrow alveolar ridge that requires bone grafting before implant placement.

Growth potential and tooth position determine whether or not an ankylosed primary second molar should be extracted. A patient with significant growth potential, such as a 15-year-old male, may require extraction of an ankylosed primary molar. This allows the alveolar ridge to develop occlusally as the adjacent teeth continue to erupt.<sup>3,13</sup> Donnelly and Swoope demonstrated that as the periosteum is stretched over an edentulous ridge, osteoblastic activity is stimulated to lay down bone and promote alveolar ridge development.<sup>14</sup> However, extraction of an ankylosed primary second molar may not be necessary in a 15-year-old female with little or no growth potential. If the primary molar is in an acceptable position, it can be maintained, but likely will require interproximal reduction and restoration of the occlusal surface to achieve an optimal occlusion.

## Conclusions

Orthodontists frequently encounter patients with congenitally missing teeth. The most common are maxillary lateral incisors and mandibular second premolars. Treatment decisions must be made based on eruption pattern, growth potential, tooth position, and tooth health. If the patient is missing one or both maxillary lateral incisors, guided eruption and ridge development are critical. Early diagnosis and treat-

ment of ankylosed primary second molars also may be important for the periodontal and restorative treatment of the adolescent patient. Therefore, monitoring these patients in the mixed dentition is essential to preserve various treatment options in the future.

## References

1. Biggerstaff RH: The orthodontic management of congenitally absent maxillary lateral incisors and second premolars: a case report. *Am J Orthod Dentofacial Orthop* 102:537-545, 1992
2. Kokich VG: Managing orthodontic—restorative treatment for the adolescent patient, in McNamara JA, Brudon WL (eds): *Orthodontics and Dentofacial Orthopedics*. Ann Arbor, MI, Needham Press, 2001, pp 423-452
3. Spear F, Mathews D, Kokich VG: Interdisciplinary management of single-tooth implants. *Semin Orthod* 3:45-72, 1997
4. Lombardi RE: The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 29:358-382, 1973
5. Freeman JE, et al: Frequency of Bolton tooth size discrepancies among orthodontic patients. *Am J Orthod* 110:24-27, 1996
6. Bolton WA: Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. *Am J Orthod* 28:113-130, 1958
7. McNeill RW, Joondeph DR: Congenitally absent maxillary lateral incisors: treatment planning considerations. *Angle Orthod* 43:24-29, 1973
8. Nordquist GG, McNeill RW: Orthodontic vs. restorative treatment of the congenitally absent lateral incisor—long term periodontal and occlusal evaluation. *J Periodontol* 46:139-143, 1975
9. Atherton JD: The gingival response to orthodontic tooth movement. *Am J Orthod Dentofacial Orthop* 58:179-186, 1970
10. Sabri R: Management of congenitally missing second premolars with orthodontics and single tooth implants. *Am J Orthod Dentofacial Orthop* 125:634-642, 2004
11. Kurol J, Thilander B: Infraocclusion of primary molars with aplasia of the permanent successor. a longitudinal study. *Angle Orthod* 54:283-294, 1984
12. Bennett J: The long term survival of lower second primary molars in subjects with agenesis of the premolars. *Eur J Orthod* 22:245-255
13. Ostler MS, Kokich VG: Alveolar ridge changes in patients congenitally missing mandibular second premolars. *J Prosthet Dent* 71:144-149, 2000
14. Donnelly MW, Swoope CC: Periosteal tension in the stimulation of bone growth in the mandible. Master's thesis. Seattle, WA, University of Washington, 1973