

Managing Congenitally Missing Lateral Incisors. Part II: Tooth-Supported Restorations

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ABSTRACT

Three treatment options exist for the replacement of congenitally missing lateral incisors: canine substitution, a tooth-supported restoration, or a single-tooth implant. Selecting the appropriate treatment option depends on the malocclusion, the anterior relationship, specific space requirements, and the condition of the adjacent teeth. The ideal treatment is the most conservative alternative that satisfies individual esthetic and functional requirements. This article closely examines the three options when replacing a missing lateral incisor with a tooth-supported restoration. These options are a resin-bonded fixed partial denture, a cantilevered fixed partial denture, and a conventional full-coverage fixed partial denture. The specific criteria that must be evaluated for each option is addressed to illustrate the importance of interdisciplinary treatment planning to achieve optimal esthetics and long-term predictability. This article is the second of a three-part series discussing the three treatment alternatives for replacing congenitally missing lateral incisors.

CLINICAL SIGNIFICANCE

When replacing the congenitally missing lateral incisor with a tooth-supported restoration, specific criteria must be evaluated by the restorative dentist and orthodontist to provide the most predictable treatment outcome.

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Maxillary lateral incisors are among the most commonly congenitally missing teeth.^{1,2} The replacement of these teeth raises several important treatment planning concerns. Therefore, it is beneficial to use an interdisciplinary treatment approach to achieve the most predictable outcome. As was previously discussed in Part I, canine substitution can be an esthetic treatment alternative for the replacement of missing lateral incisors. However, there are many individuals who do

not meet the qualifications necessary to be considered for canine substitution. In these patients some form of restoration must be considered. The restorative treatment alternatives can be divided into two categories: a single-tooth implant or a tooth-supported restoration. The three primary types of tooth-supported restorations available today are a resin-bonded fixed partial denture, a cantilevered fixed partial denture, and a conventional full-coverage fixed partial denture. The primary

consideration among all these treatment options is conservation of tooth structure. Ideally, the treatment of choice should be the least invasive option that satisfies the expected esthetic and functional objectives.

Many adolescent and adult patients lack sufficient space for a lateral incisor restoration. This is often due to ectopic eruption of the canine into the lateral incisor position. The orthodontist must move the canine distally into its appropriate

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position. This ultimately aids in achieving alveolar ridge development and optimal esthetics for the final restoration.

Over the past several years, the single-tooth implant has become a popular method of replacing missing teeth.^{3,4} With the hard and soft tissue grafting procedures that are available, implant success rates as well as the final esthetic outcome have become increasingly predictable.^{5,6} However, there are still certain instances in which implants cannot be used, such as in the patient who is unwilling to undergo the necessary treatment to facilitate proper implant placement. In these situations some form of tooth-supported restoration must be used.

Although any of the aforementioned restorative treatment options can be used to achieve predictable esthetics, function, and longevity, if a given treatment option is used in the wrong patient, the final result may be less than ideal. Therefore, it is important that the orthodontist know the final restorative treatment plan early to ensure the correct position of the adjacent teeth to facilitate the final restoration.

The subsequent portion of this article discusses the restorative indications and contraindications for each of the three types of tooth-supported restorations. In addition, it addresses the impact that tooth position has on treatment planning resin-bonded fixed partial dentures, cantilevered

fixed partial dentures, and conventional full-coverage fixed partial dentures in the replacement of congenitally missing lateral incisors.

DETERMINATION OF APPROPRIATE SPACING

The orthodontist plays a key role in determining and establishing space requirements for patients with missing maxillary lateral incisors. A question that is often asked is, How much space is necessary for the missing lateral incisor? There are three ways to determine the appropriate space for these missing teeth. The first is the "golden proportion."^{7,8} This method states that the perceived width of the anterior teeth as viewed from the direct anterior should have a ratio of 1:0.618 with the tooth adjacent to it (Figure 1). For example, a photograph of a maxillary dental arch with an 8 mm wide central incisor crown should "visually" have a lateral incisor crown width of 5 mm. The trouble



Figure 1. The "golden proportion" is a two-dimensional measurement of esthetics. It is applied dentally by viewing the arrangement of the maxillary anterior teeth in a frontal photograph. Beginning with the central incisor, each tooth should be 61.8% larger than the tooth distal to it.

with using the golden proportion is twofold. First, since this proportion is derived from the perceived size of the teeth from a direct frontal view only, there is no relation to the actual measured widths of the teeth. Second, research shows that there is not one specific lateral incisor width that is considered esthetic but, rather, a range of widths.⁹

The second method to determine the appropriate restorative space is to use the contralateral lateral incisor.¹⁰ If the contralateral tooth has a normal width, it can often be used by the orthodontist as a guide to establish ideal spacing for the missing lateral incisor. Unfortunately, this method of space appropriation is not suited for adolescents with missing or peg-shaped contralateral incisors.

A third method of space appropriation is to conduct a Bolton analysis.¹¹ Bolton first introduced his ratio in 1958 as a way to compare the mesiodistal widths of the dental arches to 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 0.78¹²:

$$\frac{\text{Sum of mandibular six teeth}}{\text{Sum of maxillary six teeth}} = \text{Bolton ratio } (\sim 0.78)$$

This ratio 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. If the sum of the mandibular six anterior teeth is 36.5 mm and the measured width of the maxillary five anterior teeth is 33.8 mm, then the width of the missing lateral incisors (x) can be calculated as follows:

$$\frac{36.5 \text{ mm}}{33.8 \text{ mm} + x} = 0.78$$

$$36.5 \text{ mm} = 0.78x + 26.36 \text{ mm}$$

$$10.14 \text{ mm} = 0.78x$$

$$13.0 \text{ mm} = x$$

The 13.0 mm is then divided by two to determine the width of each lateral incisor space (6.5 mm). Using the Bolton analysis is a quick and reliable way to determine the appropriate spacing necessary for patients with congenitally missing lateral incisors.

The most predictable guide for determining ideal spacing is to construct a diagnostic wax-up. This simplifies the treatment for the orthodontist and restorative dentist. Fortunately, most adolescents have healthy, nonrestored teeth that do not exhibit significant wear. Therefore, the spacing is ultimately determined by the occlusion and esthetics. The canines should be placed in a position that will allow proper anterior disclusion, and the central incisors should be positioned to provide optimal esthetics (Figure 2).^{10,13} The space that remains is used for the lateral incisor

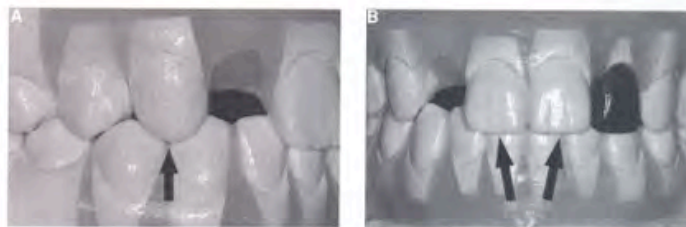


Figure 2. A, The maxillary canine should be positioned in the embrasure between the mandibular canine and first premolar. This allows for proper canine disclusion. B, The maxillary central incisors should be positioned in the appropriate overbite and inclination to achieve ideal esthetics.

restoration and generally ranges from 5 to 7 mm.

RESIN-BONDED FIXED PARTIAL DENTURE

The most conservative tooth-supported restoration is the resin-bonded fixed partial denture as it leaves the adjacent teeth relatively untouched. Although there are differences in preparation design, the classic resin-bonded fixed partial denture relies solely on adhesion without the use of pins or grooves. The success rate of this type of restoration varies widely from a 54% failure rate over 11 months to a 10% failure over 11 years, with debonding being the most common cause of failure.¹⁴⁻¹⁷ Although these restorations can be used successfully, specific criteria must be addressed to ensure optimal esthetics and long-term predictability. These criteria include the position, mobility, thickness, and translucency of the abutment teeth as well as the overall occlusion.

Tooth position, as it relates to a vertical overbite of the incisors,

can significantly impact the stresses placed at the bond interface (Figure 3). Resin-bonded fixed partial dentures placed in a deep overbite relationship have been shown to have a higher incidence of failure.¹⁸ This is due to the increased lateral forces that are placed on the abutment teeth. As the overbite increases, either the surface area available for bonding the retainer must decrease or the tooth must be prepared and the occlusion placed on the retainer. Therefore, the ideal anterior relationship for a resin-bonded fixed partial denture is a shallow overbite. This allows the maximum surface area for bonding the retainers as well as a decrease in the amount of lateral force. However, the amount of overbite is ultimately determined by the height of the posterior cusps. Adequate overbite in the anterior region is necessary to disclude the posterior teeth in excursive movements. Hence, a patient with steep posterior cusps and a deep anterior overbite may not be an ideal candidate for a resin-bonded fixed partial denture. The second concern regarding tooth position is inclination

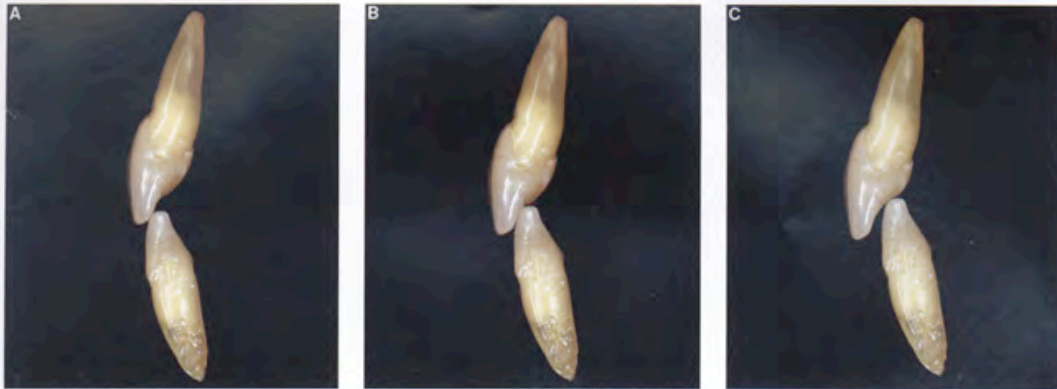


Figure 3. A–C, A shallow overbite decreases the amount of lateral forces on the abutment teeth as well as maximizes the surface area available for bonding the retainers.

of the abutment teeth. The direction of normal occlusal forces on proclined incisors creates more of a tensile force at the bond interface, whereas occlusal forces on upright incisors create more of a shear force at the bond interface (Figure 4). Based on theoretic physics principles, an object loaded with a shear force

can withstand approximately 40% more load prior to failure compared with the same object loaded with a tensile force.

Mobility of the abutment teeth is a contraindication for resin-bonded fixed partial dentures owing to the stress that is placed on the bond

interface when the rigidity of the retainer works to keep the abutment teeth from moving under load. Mobility negatively impacts the durability of the bond in two ways. When a resin-bonded fixed partial denture is placed from a mobile central incisor to a mobile canine, each abutment wants to move under occlusal load. The problem is that although each tooth moves in a buccolingual direction, this movement is on different vectors due to the position that each tooth occupies in the arch. This ultimately places great stress at the bond interface. Another factor occurs when the abutment teeth have mobilities that are different from one another, for example, one abutment is mobile and the other abutment is not. Again, there is an increased stress placed on the bond when only one of the abutments moves under occlusal load. Generally, it is the least mobile of the two abutments that debonds

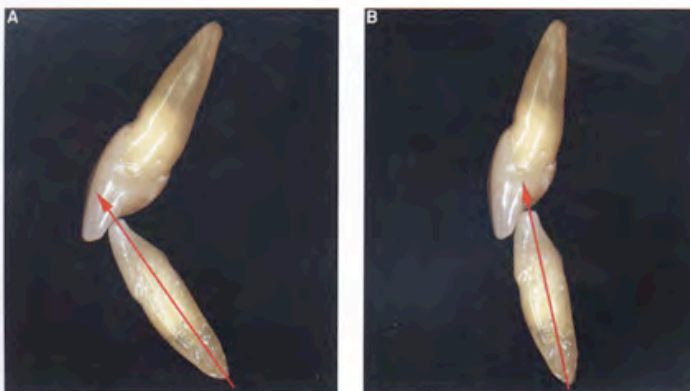


Figure 4. A, Occlusal forces on proclined incisors create a more tensile type of force at the bond interface. B, The same occlusal forces on teeth that are upright generate a more shear type of force at the bond interface.



Figure 5. A patient with a resin-bonded fixed partial denture replacing the laterals has proclined central incisors with a Grade I mobility. The restoration began debonding after placement and eventually fractured after being re cemented multiple times.

as the restoration moves in the direction of the more mobile abutment (Figure 5).

The thickness and translucency of the abutment teeth can also have a profound impact on retainer design. The coronal extension of the retainer, although influenced by the amount of overbite, is also dictated by the amount of translucency of the abutment teeth. When retainer extensions are carried too coronal, thin teeth or teeth with a high degree of translucency in the incisal one-third can appear gray due to the show through of the metal retainer (Figure 6). If the show through cannot be prevented because of the thinness of the teeth, or when the amount of bondable surface area has to be significantly reduced in an attempt to prevent graying, a resin-bonded fixed partial denture is contraindicated.

The final area of concern regarding placement of resin-bonded fixed



Figure 6. A, To gain the maximum surface area for bonding, the retainer extensions were carried up to the incisal edges of the teeth. B, The incisal one-third appears gray due to the metal retainer showing through the translucent incisal edge.

partial dentures is occlusal parafunction. The increase in occlusal force that is created with occlusal parafunction is often greater than can be withstood by the resin bond, thereby leading to an increased risk of debonding. For patients that demonstrate signs and symptoms of parafunction, an alternative treatment plan should be considered.

The ideal candidate for a resin-bonded fixed partial denture possesses abutment teeth that are nonmobile, are moderately thick, and have the translucency mainly localized in the incisal one-third

(Figure 7). A shallow overbite allows maximum surface area for bonding the retainers with little or no tooth preparation. The shallow anterior relationship also imparts the least amount of force on the bond interface.

CANTILEVERED FIXED PARTIAL DENTURE

The second most conservative tooth-supported restoration designed to replace the congenitally missing lateral incisor is a cantilevered fixed partial denture. Given its root length and crown dimensions, the canine is an ideal abutment for a cantilevered



Figure 7. A, Thick abutment teeth with minimal incisal translucency prevent show through of the retainer while still allowing its maximum extension. B, A shallow overbite also allows the retainer extensions to be carried farther incisally without the abutment teeth requiring preparation.



Figure 8. A patient with a congenitally missing lateral incisor presents after having two implants previously fail in the edentulous site. The patient does not want to undergo any more surgery for implant placement or grafting. Note the proclination of the central incisors.

restoration. Compared with the resin-bonded fixed partial denture, the success of this type of restoration is not dependent on the amount of proclination or mobility of the abutment teeth (Figure 8).

If the facial esthetics of the canine abutment does not need to be altered, the most conservative cantilevered restoration uses a partial-coverage preparation.¹⁹ Retention and resistance of a partial-coverage preparation require the use of pins; therefore, pulpal size and location within the tooth must be evaluated. Due to the large pulp size present in many young patients, age may be a relative contraindication. Similar to the resin-bonded fixed partial dentures, the thickness and translucency of the abutment must be evaluated to prevent show through of the retainer. The completed preparation uses pins placed on the distal and in the area of the cingulum, with a groove on the mesial (Figure 9). The remainder of the preparation varies



Figure 9. A and B, The final preparation of the partial-coverage pin-ledge cantilever restoration. The pins and groove in the preparation enhance the resistance and retention form.

in depth from 0.5 to 0.75 mm. The final partial-coverage cantilevered restoration is bonded in place using resin cement (Figure 10).

If the canine abutment requires a change in the facial contour to enhance the esthetics, a conventional full-coverage preparation can be done to support the cantilevered lateral pontic. The key to the long-term success of the cantilevered fixed partial denture is managing the occlusion on the pontic.^{20,21} It is imperative that all contact in excursive movements be removed from the cantilever. If eccentric contact remains on the pontic, the potential

risks include loosening of the restoration, migration of the abutment, and fracture.

CONVENTIONAL FULL-COVERAGE FIXED PARTIAL DENTURE

The least conservative of all tooth-supported restorations is a conventional full-coverage fixed partial denture. This restoration is considered the treatment of choice when replacing an existing fixed partial denture or when the adjacent teeth require restoration for structural reasons (eg, caries, fracture) or to alter the facial esthetics. An additional benefit of a conventional fixed partial denture is the degree of



Figure 10. A and B, The extensions of the retainer are determined by the occlusion and the translucency in the incisal one-third of the abutment. The restoration is bonded with resin cement. It is imperative that all eccentric contacts be removed from the pontic.

control it exerts over the occlusion and occlusal forces. However, given the amount of tooth preparation required for the conventional fixed partial denture, it is not considered the ideal treatment for replacement of congenitally missing laterals in young patients. If a conventional fixed partial denture is treatment planned and the patient is or will be undergoing orthodontic therapy, there are specific considerations regarding tooth position that should be addressed to facilitate preparation of the abutment teeth.

One area of concern that should be addressed for full-coverage restorations is the alignment of the anticipated abutment teeth along a common pathway. When the orthodontist aligns the central incisor and canine during treatment, it is important to evaluate the inclination and angulation of these teeth. When looking at the patient's teeth from a frontal perspective, it is imperative that the long axis of the central incisor and the labial surface of the canine are parallel (Figure 11A). This allows the restorative dentist the proper "line of draw" when preparing these teeth. If the inclination of the canine is incorrect, the restorative dentist has to overprepare the teeth to achieve the proper line of draw (Figure 11B). This may ultimately weaken the abutments or impinge on the pulp chamber.

When evaluating the patient's teeth from a lateral perspective, the long axis of the canine and the labial

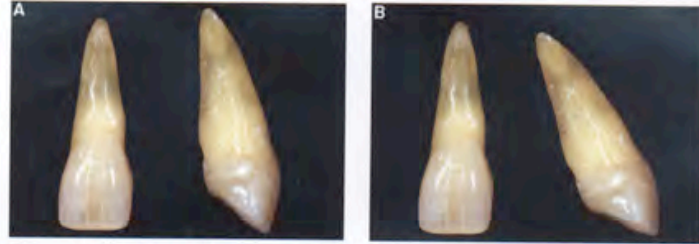


Figure 11. A, When evaluating a patient from a frontal perspective, it is important to confirm that the long axis of the central incisor is parallel to the labial surface of the canine crown. B, Poor inclination and angulation of the central incisor and canine can result in excessive tooth preparation to establish the proper "line of draw" for a bridge restoration.

surface of the central incisor must also be parallel for proper tooth preparation (Figure 12A). If proclination of the central incisors is too great at the completion of orthodontic treatment, it is difficult for the restorative dentist to adequately prepare the teeth for proper esthetics as well as the appropriate line of draw (Figure 12B). If the central incisor and canine are positioned correctly, tooth preparation for a conventional fixed partial denture is simplified; therefore, the orthodontist must know how to align these teeth according to the specific re-

storative requirements for the chosen restoration. He or she must also know the orthodontic limitations that may suggest selection of an alternate restoration to replace the missing lateral incisor.

Another consideration is the faciolingual position of the abutment teeth as it relates to palatal tooth preparation and joint size. This is especially true when placing all-ceramic fixed partial dentures. It is known that failure of all-ceramic fixed partial dentures is commonly a problem of joint fracture caused

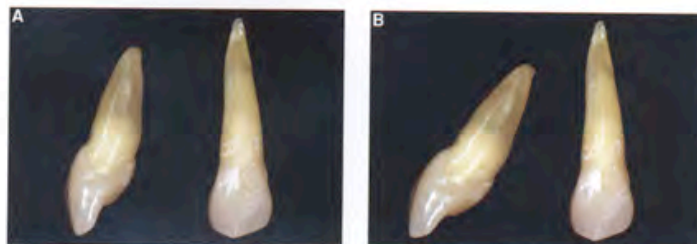


Figure 12. A, When evaluating a patient from a lateral perspective, the long axis of the canine and facial surface of the central incisor should be parallel. B, An increased proclination of the central incisors often makes it difficult for the restorative dentist to conservatively prepare these teeth to receive a bridge restoration.



Figure 13. The orthodontist can leave an excess overjet to help increase the buccolingual dimension of the joint and allow more definitive facial embrasures without jeopardizing the strength of the joint.

by inadequate joint size.^{22,23} The orthodontist can help increase the size of the joint by leaving an anterior open bite or excess horizontal overjet of approximately 0.5 to 0.75 mm (Figure 13). This excess space can ultimately be closed with the final restoration, thereby increasing the joint dimension. Any excess space remaining on the adjacent unrestored teeth can be closed with direct composite bonding. The other advantage to leaving some excess overjet is that it allows a more conservative palatal preparation, which can be important in patients with thin teeth.

SUMMARY

Many restorative options exist for the replacement of congenitally missing lateral incisors, including the resin-bonded fixed partial denture, the cantilevered fixed partial

denture, and the conventional full-coverage fixed partial denture. Each of these restorative options can be used with a high degree of success if used in the correct situation. The most conservative of these restorations is the resin-bonded fixed partial denture, although this alternative requires that stringent criteria be met to ensure its longevity. The cantilevered fixed partial denture can be designed using either a partial-coverage or a conventional full-coverage retainer. The success of this type of restoration is dependent on the ability to control the occlusal contacts on the pontic. The conventional full-coverage fixed partial denture can be used in a variety of situations or occlusal schemes, although it is the least conservative of the three treatment options. Depending on the type of final restoration that is chosen, interdisciplinary management of patients with congenitally missing lateral incisors often plays a vital role in the facilitation of treatment. By working together, the restorative dentist and orthodontist can produce predictable and esthetic treatment results.

REFERENCES

1. Graber LW. Congenital absence of teeth: a review with emphasis on inheritance patterns. *J Am Dent Assoc* 1978; 96:266-275.
2. Dermaut LR, Goeffers KR, DeSmit AA. Prevalence of tooth agenesis correlated with jaw relationship and dental crowding. *Am J Orthod Dentofacial Orthop* 1986; 90:204-209.
3. Mayer TM, Hawley CE, Gunsolley JC, Feldman S. The single-tooth implant: a viable alternative for single-tooth replacement. *J Periodontol* 2002; 73:687-693.
4. Naert I, Koutsikakis G, Duyck J, Quirynen M, Jacobs R, van Steenberghe D. Biologic outcome of single-implant restorations as tooth replacements: a long-term follow-up study. *Clin Implant Dent Relat Res* 2000; 2:209-218.
5. Davarpanah M, Martinez H, Etienne D, et al. A prospective multicenter evaluation of 1,583 3i implants: 1 to 5-year data. *Int J Oral Maxillofac Implants* 2002; 17: 820-828.
6. Romeo E, Chiapasco M, Ghisolfi M, Vogel G. Long-term clinical effectiveness of oral implants in the treatment of partial edentulism. Seven-year life table analysis of a prospective study with ITI dental implants system used for single-tooth restorations. *Clin Oral Implants Res* 2002; 13:133-143.
7. Levin EL. Dental esthetics and the golden proportion. *J Prosthet Dent* 1978; 40: 244-252.
8. Lombardi RE. The principles of visual perception and their clinical application to denture esthetics. *J Prosthet Dent* 1973; 29:358-382.
9. Kokich VO Jr, Kiyak HA, Shapiro PA. Comparing the perception of dentists and lay people to altered dental esthetics. *J Esthet Dent* 1999; 11:311-324.
10. Spear F, Mathews D, Kokich VG. Interdisciplinary management of single-tooth implants. *Semin Orthod* 1997; 3:45-72.
11. Freeman JE, Maskaroni AJ, Lorton L. Frequency of Bolton tooth-size discrepancies among orthodontic patients. *Am J Orthod* 1996; 110:24-27.
12. Bolton WA. Disharmony in tooth size and its relation to the analysis and treatment of malocclusion. *Am J Orthod* 1958; 28: 113-130.
13. McNeill RW, Joondeph DR. Congenitally absent maxillary lateral incisors: treatment planning considerations. *Angle Orthod* 1973; 43:24-29.
14. Williams VD, Thayer KE, Denehy GE, Boyer DB. Cast metal, resin-bonded prostheses: a 10-year retrospective study. *J Prosthet Dent* 1989; 61:436-441.
15. Hansson O. Clinical results with resin-bonded prostheses and an adhesive cement. *Quintessence Int* 1994; 25:125-132.
16. Priest GF. Failure rates of restorations for single-tooth replacement. *Int J Prosthodont* 1996; 9:38-45.
17. Probst B, Henrich GM. 11-year follow-up

- study of resin-bonded fixed partial dentures. *Int J Prosthodont* 1997; 10:259-268.
18. Creugers NH, Kayser AF, Van't Hof MA. A seven-and-a-half-year survival study of resin-bonded bridges. *J Dent Res* 1992; 71:1822-1825.
19. Small BW. The use of cast gold pinledge retainers with pontics as an esthetic and functional restorative option in the maxillary anterior. *Gen Dent* 2004; 52(1): 18-20.
20. Decock V, De Nayer K, De Boever JA, Dent M. 18-year longitudinal study of cantilevered fixed restorations. *Int J Prosthodont* 1996; 9:331-340.
21. Hochman N, Ginio I, Ehrlich J. The cantilever fixed partial denture: a 10-year follow-up. *J Prosthet Dent* 1987; 58:542-545.
22. Kelly JR, Tesk JA, Sorensen JA. Failure of all-ceramic fixed partial dentures in vitro and in vivo: analysis and modeling. *J Dent Res* 1995; 74:1253-1258.
23. Oh WS, Anusavice KJ. Effect of connector design on the fracture resistance of all-ceramic fixed partial dentures. *J Prosthet Dent* 2002; 87:536-542.

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