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ASK AN EXPERT

THINGS YOU WANT TO KNOW

Improving the esthetic outcome of canine substitution for missing maxillary lateral incisors

Your recent article on the potential esthetic long-term problems with single implant-supported crowns in the anterior maxilla (World J Orthod 2006;7:306–312) was interesting and informative. For years I've tried to achieve what I thought of as ideal results by opening spaces for missing lateral incisors. Now, I have completely gone the other way whenever possible for several reasons. The biggest reason is practical, in that I disliked finishing cases at age 14 or so and then having to wait 4 to 10 years before placing the implant. I had several cases in which the adjacent roots moved enough for additional treatment to be necessary. I also did not like finishing cases with large anterior spaces. Even though this was completely explained at the consultation appointment, everyone is somewhat disappointed once they see the retainer with plastic teeth. Additionally, not every dentist in my area is comfortable doing resin-bonded fixed partial dentures, so we have to make do with a removable retainer for some time while we wait to do the implants.

Another limitation I found were financial problems for the parents when implants were planned, since implants are frequently done at the same time college expenses are due.

While dentists will argue that an implant in the lateral space is ideal for esthetic reasons, it is not always seen that way by the public. When I show before and after images of cases treated with space closure to parents, they frequently state that they would be very happy with that result for their child. In fact, I am so committed to the idea of space closure that I will occasionally close the anterior space and open space between the premolars for an implant. I feel that this is frequently a more ideal solution considering all the variables. My patients seem pleased with this approach since they have a "proper" smile when the appliances are removed.

I also have been influenced by your JCO article with Dr Marco Rosa on integrating esthetic dentistry and space closure for missing lateral incisors. Since that article was published in 2001, I wonder if there is any new clinical or scientific information that will help improve the treatment results for these challenging cases? —Charles J. Ruff, Waterville, ME

Common esthetic problems with orthodontic space closure

The most apparent difficulty when using canine substitution for missing maxillary lateral incisors is to achieve an excellent esthetic outcome that resembles a natural dentition. Particularly in unilateral agenesis cases, space closure can create a problem in matching size, shape, and color (Fig 1). This is due to the fact that the canine normally is a longer and larger tooth (mesiodistally and labiolingually) than the lateral incisor it will be replacing, and more saturated with color. Furthermore, the first premolar is generally shorter and narrower than the contralateral canine (Fig 1). If these differences are not compensated for, the esthetic outcome will be compromised.[1–3] It seems to be a particularly common fault among orthodontists[4–7] not to address the natural size difference between a first premolar and a canine, so that the premolar(s) substituting for canine(s) becomes too diminutive (see Fig 1).

Advantages of orthodontic space closure

The major advantage of orthodontic space closure for young patients with agenesis of the maxillary lateral incisor and any coexisting malocclusion is the permanence of the finished result. The alveolar bone height in the actual region is maintained by the early mesial movement of the canine, and the need for removable or resin-bonded retainers until implants can be placed is avoided. At the end of the orthodontic treatment, the overall treatment can be completed, and the result is permanent. An ultra-thin porcelain veneer, if desired, can be placed directly on any of the anterior teeth, because the 2 common reasons to postpone permanent prosthetics in young patients (risk of pulp perforation and exposure of gingival crown margins during tooth eruption) are not contraindications for a minimally invasive preparation with enamel-bonded porcelain (Figs 2 to 4).

Fig 1 Common esthetic problems with canine substitution for unilateral agenesis of maxillary lateral incisor. The treatment result is not optimal, since there is obvious asymmetry between the teeth on the right side (agenesis side) and those on the left side (natural intact side). Even after incisal contouring, the canine is too wide and too long (compared with the natural left lateral incisor) and the first premolar substituting for the canine is too small and too short. The gingival margins differ between the right and left sides.

Fig 2 Unilateral agenesis of the maxillary right lateral incisor in a 14-year-old female patient. Note the midline deviation toward the agenesis side, anterior crowding with overlapping central incisors with triangular shape, and deep overbite **(a to c)**.The treatment plan was canine substitution on the right side and extraction of the left first premolar. Bracket placement on the first premolar was more incisal and on the canine more gingival than usual **(d)**, which provided their intrusion and extrusion, respectively, during the leveling stage **(e)**. The premolar intrusion was maintained throughout treatment with stainless steel rectangular archwires **(f)**. The connector areas of the central incisors were lengthened by mesiodistal contouring. The deep bite was corrected by intrusion of the mandibular incisors with a 0.175 × 0.025-inch CNA overlay base arch **(f,g)**. Additional lingual root torque on the incisors was achieved by a von der Heydt torquing auxiliary wire on the central incisors **(h,i)**.

Disadvantages of orthodontic space closure

The tendency of the space between the anterior teeth to reopen after space closure for missing maxillary lateral incisor(s) in a young patient is the major disadvantage of this treatment option.[8] However, the space reopening tendency after treatment can be overcome with long-term fixed retention with a lingually bonded flexible spiral wire retainer from first premolar to first premolar in the maxilla[1] (see Fig 4f). If patients are instructed to contact their orthodontist in the case of retainer failure or breakage, and manage to do so, the repair of the bonded retainer is generally fast and uncomplicated. The bonded retainer should be supplemented with a removable plate to be used continuously for 6 months and then at night. No apparent side-effects were noticed with this regimen in a 10-year follow-up study.[9] The bonded retainer wire can usually be cut distal to the canines after some years, so that only the canines and central incisors are included. Should spaces still open up distal to the canines, these can be filled with composite resin buildups.

Fig 3 Same unilateral agenesis case as in Fig 2, at the end of treatment **(a to f)**. Porcelain veneers (courtesy of Dr Sverker Toreskog, Göteborg, Sweden) were placed on the intruded first premolar (substituting for the canine) and on the extruded canine (replacing the missing right lateral incisor). The tooth sizes, shapes, and colors are almost identical on the agenesis side **(d,e)** and on the intact side, with symmetric gingival contours. The maxillary midline is slightly overcorrected relative to the mandibular teeth **(b)** and parallel to the facial midline **(f)**.

Professional and layperson preferences for space closure or opening

A recent study by Armbruster et al[6,7] tried to determine how general dentists (n = 140), orthodontists (n = 43), combined dental specialists (n = 29), and laypeople (n = 40) judged the relative attractiveness of a series of photographs of teeth that included cases with agenesis of lateral incisors. The photographs comprised cases with resin-bonded fixed partial dentures, implants, and orthodontic space closure with canine substitution. Cases with no missing teeth were used as controls. The results indicated that the lay population ranked photographs of the canines as lateral incisors as the best of all options. The orthodontists rated each category statistically significant from each other in the following order from best to worst: no missing teeth, canines as lateral incisors, resin-bonded fixed partial dentures, and implants. Compared to orthodontists, a significantly greater percentage of general dentists and dental specialists would restore the lateral incisors with implants and would do so primarily for esthetic reasons. Interestingly, however, for those professionals who preferred restoration, many did not rank any photograph of a restorative option as the best option. It was concluded that dentists should attempt to eliminate their personal opinions regarding what they believe is the more esthetic option when planning treatment for patients with agenesis of the lateral incisors. Instead, patients should be informed of the available treatment options, based on the advantages and disadvantages of each, relative to their own clinical situation. Generally, the treatment of choice should be the least invasive option that satisfies the expected esthetic and functional objectives.[5]

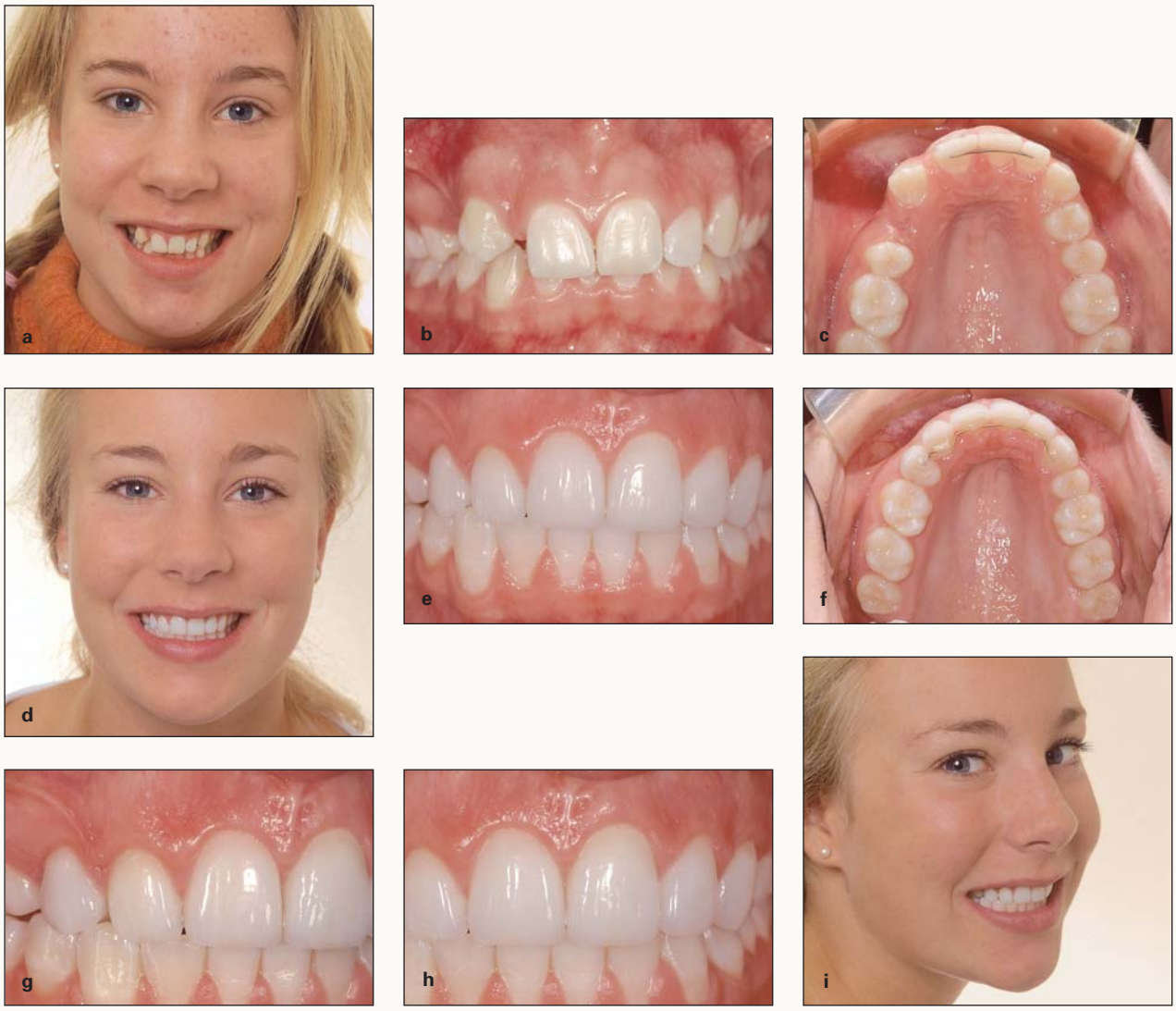

Fig 4 Young girl, 12 years 8 months of age, with deep overbite, agenesis of the maxillary right lateral incisor, and also missing the right first premolar **(a to c)**. Treatment included extraction of the left first premolar and space closure for the 2 missing teeth in the maxillary right quadrant. The final result after 3 years of orthodontic treatment and 6 porcelain veneers (made by Dr Toreskog) is shown **(d to i)**. The right canine is substituting for the lateral incisor, and the second premolar is placed in the canine position. Note symmetric and natural gingival margins of the maxillary anterior teeth. There is a slight maxillary midline deviation, but the connector area is parallel to the facial midline **(d)**. Note the identical morphology of the restored right canine (acting as lateral incisor) and the left lateral incisor, and also that of the right second premolar in the canine position and the canine on the left side. After eruption of the third molars **(f)**, the patient has an adequate supply of teeth.

No evidence for establishment of Class I canine relationship

Long-term periodontal and occlusal studies on different treatments for missing lateral incisors have shown that space closure with premolar substitution for canines can lead to an acceptable functional relationship, with modified group function on the working side. Nordquist and McNeill[10] re-examined 33 treated patients with at least 1 missing maxillary lateral incisor (39 cases with space closure and 19 with space reopening and fixed partial denture replacement). The mean postorthodontic treatment interval was 9 years 8 months, with a range of 2.3 to 25.6 years. They found that *(1)* patients with lateral incisor spaces closed were significantly

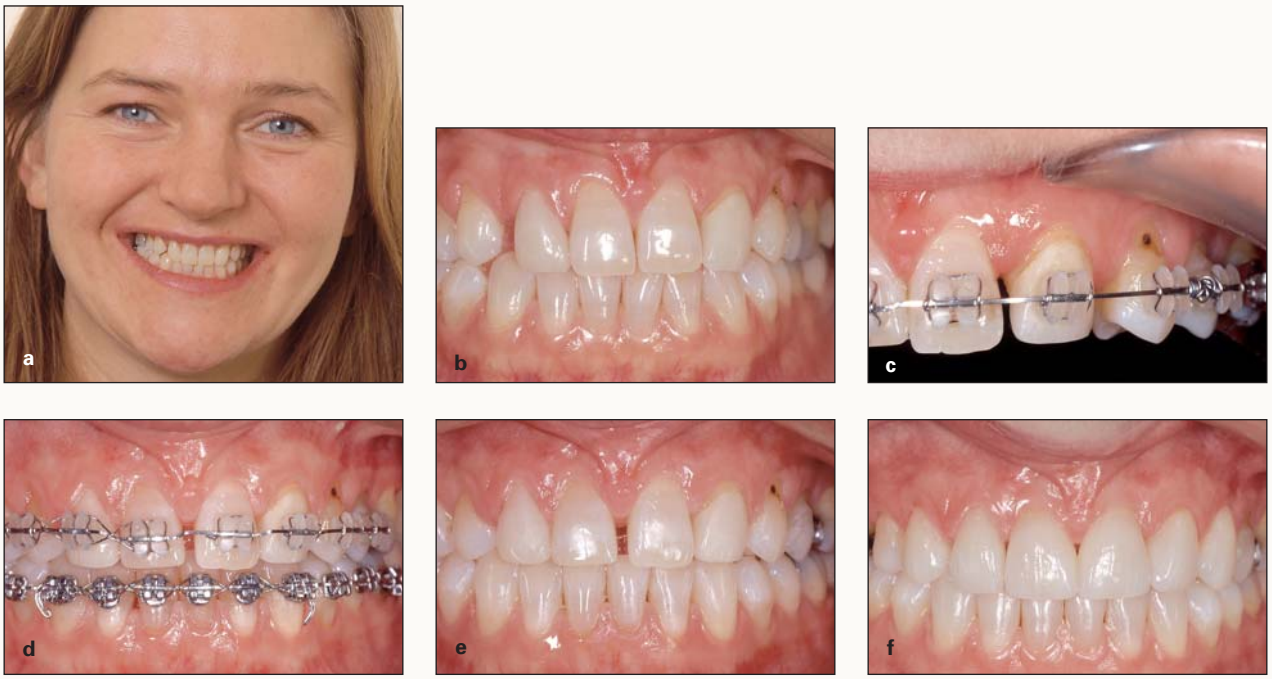

Fig 5 Young adult female patient, 35 years of age, with agenesis of the maxillary right canine and left lateral incisor **(a,b)**. Note the marked labial gingival recessions pretreatment on all maxillary anterior teeth **(b)**. There is a moderate excess of space in the maxilla. Both central incisors are narrow mesiodistally and do not conform well with her broad face **(a)**. The treatment plan was to recontour and narrow the left canine by mesiodistal stripping **(c)**, and open up space between the central incisors **(d,e)** so that these teeth could be made wider with porcelain veneers **(f)**. Porcelain veneers were also made (by Dr Toreskog) on the right first premolar (substituting for the canine) and lateral incisor, and on the left canine and first premolar, substituting for the left lateral incisor and canine, respectively **(f)**. Even with the recessions, the crown morphology of all maxillary anterior teeth is improved, and the gingival marginal contours show the normal high-low-high pattern.

healthier periodontally than those with prosthetic lateral incisors, *(2)* there was no difference in adequacy of occlusal function between the 2 groups, and *(3)* there was no evidence to support that establishing a Class I canine relationship should be a preferred mode of treatment. They concluded that maintaining a natural dentition is a valid treatment planning objective.

More recently, Robertsson and Mohlin[11] re-evaluated 50 treated patients with lateral incisor agenesis (mean age 26 years; range 18 to 55). The mean time after treatment was 7.1 years (range 0.5 to 13.9). Thirty patients had received space closure, and 20 had space opening for prosthetic replacement (porcelain bonded to gold and resin-bonded fixed partial dentures). They found that *(1)* the space closure patients were more satisfied with the treatment results than the prosthesis patients, *(2)* there was no difference between the 2 groups in prevalence of signs and symptoms of temporomandibular joint (TMJ) dysfunction, and *(3)* patients with prosthetic replacements had impaired periodontal health with accumulation of plaque and gingivitis. These authors concluded that orthodontic space closure produces results that are well accepted by patients, do not impair TMJ function, and encourage periodontal health in comparison with prosthetic replacements.

Integrating esthetic dentistry and space closure for missing lateral incisors

As discussed elsewhere,[1] considerable improvement can be achieved today with the space closure alternative by combining techniques from esthetic dentistry and carefully detailed orthodontic treatment. Such treatment may include:

- Careful correction of the crown torque of a mesially relocated canine to mirror the optimal lateral incisor crown torque, along with the provision of optimal torque and rotation for the mesially moved maxillary first and second premolars.
- Esthetic recontouring of a mesially relocated canine to a more ideal lateral incisor shape and size by grinding and composite resin buildups or porcelain veneers.
- Intentional vital bleaching of a yellowish canine that has been moved mesially into the lateral incisor position.
- Individualized extrusion and intrusion during the mesial movement of the canine and first premolar, respectively, to obtain an optimal level for the marginal gingival contours of the anterior teeth.
- Increasing the width and length of mesially moved and intruded first premolars with composite resin buildups and/or porcelain veneers.
- Simple minor surgical procedures for localized clinical crown lengthening.

These techniques, when used in combination, can provide the needed improvements to approach the look of a natural intact dentition, and can thus make orthodontic space closure a more attractive treatment alternative than ever before for patients with missing lateral incisors (see Figs 2 to 5).

Some keys to clinical treatment

Cosmetic contouring of canines

As demonstrated by Tuverson,[12] it is possible to recontour a canine to an almost-ideal lateral incisor shape by grinding with diamond instruments. Possible side-effects of grinding, such as increased sensitivity to heat and cold as well as other pulp and dentin reactions, can be prevented with careful attention to 2 procedures: adequate cooling with abundant water and air spray, and preparation of smooth and self-cleansing surfaces without interdental steps.[9,13] The mesiodistal dimension should be reduced (see Fig 5c), particularly on the distal surface, which may be too convex compared to a lateral incisor. The mesial margins may also be too convex, but this can also be corrected with composite resin corners.

Marginal gingival contours

A natural-looking marginal gingival contour will be at the same level for the central incisor and canine, with the lateral incisor at a more incisal level (see Fig 1, left side). The greatest esthetic challenge for canine substitution cases is to obtain such a normal gingival contour (see Fig 1, right side). However, we know now that extrusion of the canine and intrusion of the first premolar can solve this problem.[1,14] Since the canines are thicker than lateral incisors, their extrusion may create excessive occlusal contact with the mandibular incisors. This should be corrected by moving the canines labially, increasing their lingual root torque, and grinding their lingual surfaces.

Composite resin buildups for the first premolars

The easiest way to intrude the first premolars (and extrude the canines) is by bracket placement according to the gingival margin heights rather than cusp tip. Typically, the brackets on the canines should be placed at a distance from the gingival margin that will erupt these teeth into the appropriate lateral incisor vertical position.[5] The brackets on the first premolars should be positioned in an incisal location (see Fig 2d). This will automatically intrude the first premolars and extrude the canines already during the leveling stage (see Figs 2e and 2f), and may make later adjustment bends unnecessary. After the teeth have been aligned, there is a need for restorative treatment on the first premolar to recreate ideal canine size and contour. Such buildups are inexpensive and easy to make with one of the new hybrid composite resin materials (like Enamel Plus HFO; Micerium, Avegno, Italy).

Porcelain veneers

It is, of course, possible to use one or more minimally invasive porcelain veneers to almost perfectly recontour the mesially relocated canine and first premolar into "normal" lateral incisor and canine shapes, respectively[15–18] (see Figs 3 to 5). Porcelain veneers on the canines and first premolars (see Figs 3 and 4), as well as on the central incisors if these teeth need to be widened (see Fig 5) and/or elongated, are more expensive for the patient than grinding and buildups, but they compare favorably with the cost of restorations on single-tooth implants.[15]

When choosing between space closure and space opening for implants during treatment planning of the adolescent patient with missing maxillary lateral incisors, consider that the mesially moved canines and first premolars can be reshaped with composite resin or porcelain veneers immediately after the orthodontic appliances are removed, with little effort and moderate cost to the patient. This procedure will restore these teeth to approximate a natural-looking intact dentition and greatly improve the esthetic outcome of the orthodontic treatment (see Figs 2 to 5).

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Have a question you would like to see featured in this column?

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