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First premolars substituting for maxillary canines—Esthetic, periodontal and functional considerations

*There are clinical situations in orthodontics when the-treatment results show that the maxillary first premolars have been moved to the position normally occupied by the canines. This may be the case, for example, (1) when space closure is selected as the treatment alternative for missing lateral incisors; (2) in some cases with severely displaced impacted canines, which are extracted rather than orthodontically corrected; and (3) in some transposition situations. Since the clinical crown length of premolars generally is much shorter than that of the canines, substituting maxillary first premolars for canines may create an **esthetic** problem, particularly in unilateral cases, This may be a problem particularly in persons with a high lip line, who display much gingival tissue when smiling. Furthermore, the differences in number of roots and in root morphology between maxillary first premolars and canines might be a reason for long-term **periodontal** and **functional** problems. What is the currently available evidence-based research and clinical information in these areas?*

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Differences in clinical crown length between premolars and canines

Space closure and canine substitution for congenitally missing maxillary lateral incisors has been a viable treatment option for decades.¹ Following recontouring of the canine by grinding with diamond instruments¹⁻³ and/or making a composite resin mesial “corner,”^{2,3} and providing its crown with proper maxillary lateral incisor axial inclination (torque), acceptable esthetic results may be achieved for the four anterior teeth. However, even in excellently treated cases, the marginal gingival contours of the six maxillary anterior teeth will, as a rule, deviate from the optimal “high-low-high”-situation because of the short premolar and long canine clinical crowns (Figs 1 and 2). This may constitute an esthetic problem in patients who show a considerable amount of maxillary gingiva when smiling. The esthetic problem may be more pronounced in unilateral (Fig 1) than in bilateral agenesis cases (Fig 2).

The different crown lengths between premolars and canines may be handled by using one of four options:

1. Accept the differences (see Figs 1 and 2).
2. Make a simple local labial gingivectomy on the first premolar(s) (Figs 3 and 4)
3. Do surgical crown lengthening on the premolar(s).

Fig 1 Young female patient with agenesis of the right maxillary lateral incisor and a peg-shaped left lateral incisor before **(a)** and after treatment **(b)**. Note marked clinical crown length difference between the right first premolar and the left canine.

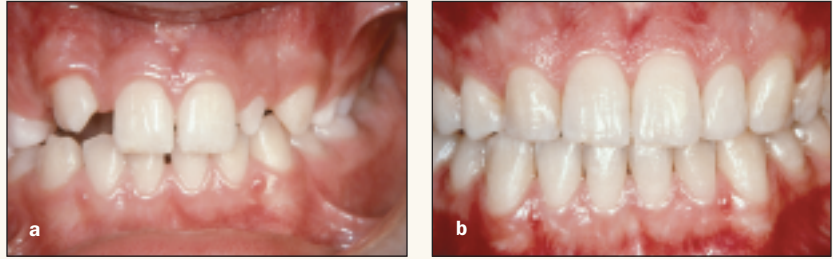


Fig 2 Young female patient with bilateral agenesis of the maxillary lateral incisors treated with orthodontic space closure **(a,b)**. Note that the marginal gingival levels of the first premolars are located more incisally than those of the canines. The canines have been ground with diamond burs to resemble natural lateral incisors.

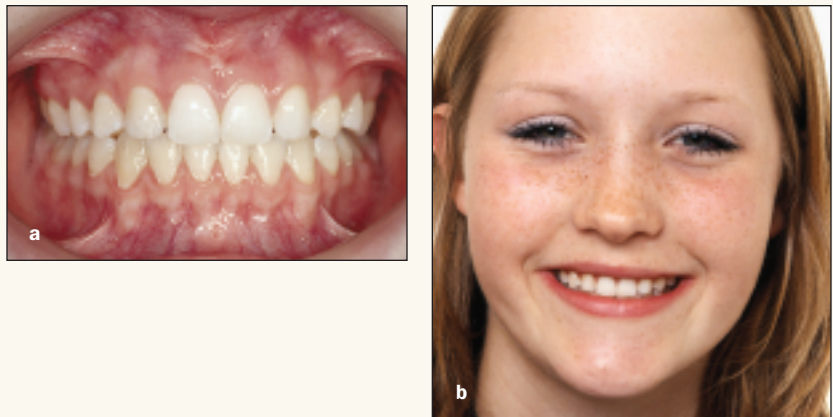


Fig 3 Treatment result after space closure treatment in young patient with bilateral agenesis of the maxillary lateral incisors. The short clinical crowns at the end of treatment **(a)** were associated with somewhat hyperplastic gingival tissues. Following local gingivectomies **(b)**, the clinical crowns of all six anterior teeth are increased. The low attaching frenum was relocated apically by a frenotomy **(b,c)**.



Fig 4 Simple gingivectomy of first premolar substituting for the maxillary right canine in space-closure case. The canine has been ground incisally **(a)**. Five years later **(b)**, the gingival tissues are healthy with intact interdental papillae between all teeth, but the clinical crown of the premolar is still shorter than that of the canine **(b)**. The probing depth is only about 1 mm **(c)**.



Fig 5 Intrusion and incisal build-up of the right first premolar substituting for the canine in space-closure case with absent lateral incisor. The intrusion is achieved with small mesial and distal archwire step-bends **(a)**. After treatment, the intruded premolar **(b)** has been provided with a hybrid composite incisal build-up (case treated by Dr Marco Rosa, Trento, Italy). Note the more normal gingival margins at the end of treatment **(c)**.

4. Extrude the canines and intrude the first premolars during the orthodontic treatment, restore the canines, and provide the premolars with a hybrid composite incisal build-up at the end of treatment.⁴

From a historical perspective, improvements of orthodontic treatment results have been gradual through these options.

Gingivectomy

By making a local gingivectomy of the marginal gingiva to the bottom of the probing pocket depth, it is possible to permanently increase the clinical crown length of any tooth that needs to be lengthened, and also to predict how much increase in crown length the gingivectomy will provide. A good part of the excised gingiva will always regenerate. According to studies by Monefeldt and Zachrisson,⁵ about 45% of the original probing depth may be maintained over time. This means that if the probing depth at the time of gingivectomy is 4 mm, and the gingivectomy is extended to the bottom of the pocket, a permanent gain in crown length of about 2 mm can be expected. Such situations may occur after orthodontic treatment when the marginal gingiva may be somewhat hyperplastic, due to the obvious difficulties for performing optimal oral hygiene measures when fixed appliances are worn (see Fig 3). On the other hand, if the probing pocket depth is only 2 mm when the gingivectomy is done, only a limited permanent gain of 1 mm, or less, can be expected (see Fig 4). Such an increase might still be of clinical value.

Surgical crown lengthening

If more crown length increase is desired to correct gingival margin asymmetries than can be achieved with a gingivectomy, a more radical option may be to perform a surgical crown lengthening with removal of alveolar bone.^{6,8} Following an apically positioned flap operation, the ostectomy/osteoplasty should be planned and performed so that bone is removed to about 3 mm from where the future gingival margin is planned.^{6,8} This allows for a “biological width” (connective tissue and epithelial attachment) of about 2 mm, and a gingival sulcus depth of 0.5 to 1 mm after the operation. There are marked individual variations in the stability of the soft tissue levels after the surgery.^{6,8} Some patients may show an increase in the amount of gingival recession during the healing period, and some may show a coronal regrowth of the gingival margin.⁶ The gingival regrowth in a coronal direction from the level defined at surgery is more pronounced in patients with thick tissue biotype than in patients with thin tissue biotype.⁸ It is also influenced by individual variations in the healing response.^{6,8} In visible areas, any occurrence of gingival recession should be observed for at least 6 months before a final restoration is planned.⁶

Intrusion of the first premolar and build-up

The gingival tissue on the labial aspects of first premolars that have been moved mesially into the position of the canines is often thin. Surgical procedures like gingivectomy and crown lengthening may cause further thinning of the tissue and imply a potential risk for future recession caused by mechanical trauma (vigorous toothbrushing), traumatic occlusion, or periodontal disease in the thin tissues. For these reasons, a recently introduced nonsurgical alternative for crown lengthening⁴ is of interest. It consists of orthodontic intrusion of the first premolar (Figs 5a and 5b) and posttreatment build-up with hybrid composite resin (Figs 5c, 7e and 7f) or an ultra-thin enamel-bonded porcelain laminate veneer (PLV) (Figs 6j to 6l)

By using small step-bends (Figs 5a, 6g, and 7c) to combine intrusion of the first premolar and extrusion of the canine, the marginal gingival levels of the six anterior teeth will approach a normal “high-low-high” contour (Figs 6 and 7). Histologic studies have demonstrated that the gingival margins will follow the teeth that are extruded⁹ or intruded¹⁰ to about 80% of the distance.⁹ The incisal portions can be restored to almost normal morphology in various ways. The first premolar may be provided with composite resin build-ups (see Figs 7e and 7f) or a PLV (see Figs 6j and 6k). The canine can be ground incisally (see Figs 6f and 7c) and provided with a mesial composite corner (see Figs 7e and 7f) or restored with a PLV (see Figs 6j and 6k). With the completion of the case, there should be few clues, even to the enlightened observer, to distinguish the affected side from a natural situation (see Figs 6i to 6l, 7e and 7f).

Future applications

An easier and probably gentler way to selectively intrude and extrude different teeth than making step-bends in the archwires during space closure would be to use bracket placement at the time of bonding as a guide for the future level of the marginal gingiva. If space closure is chosen as the treatment for a missing maxillary lateral incisor (Fig 8a), the desired intrusion of the first premolar can be achieved already during the leveling stage by placing the premolar bracket in an incisal location on the crown. Similarly, the desired canine extrusion can be achieved by positioning the canine bracket more apically than normally (Figs 8b and 8c). Further adjustment to optimal heights can be made using step-bends in the later stages of treatment.

Periodontal and functional considerations

With space closure, part of the treatment involves movement of the first premolars into the site of the maxillary canines. This change in tooth arrangements naturally has an impact on the functional occlusion. Some clinicians have expressed concerns that the forces generated through lateral excursive movements placed on the smaller and thinner roots of the first premolars will induce bone loss and periodontal problems.¹¹ However, such claims are not supported by any evidence. Long-term periodontal and occlusal studies on congenitally missing lateral incisors by different investigators^{12,13} have shown that space closure with premolar substitution for canines may lead to an acceptable functional relationship, with modified group function on the working side. Nordquist and McNeill¹² re-examined 33 treated patients with at least one missing maxillary lateral incisor (39 regions with space closure and 19 with space reopening and fixed partial denture [FPD] replacement). The mean postorthodontic treatment interval was 9 years 8 months, with a range from 2.3 to 25.6 years. They found that (1) patients with lateral incisor spaces closed were significantly healthier periodontally than patients with prosthetic lateral incisors, (2) there were no differences in adequacy of occlusal function between the two groups, and (3) no evidence to support the contention that establishment of a Class I canine relationship



Fig 6 Difficult trauma case in which the maxillary right lateral and central incisors were ankylosed and extracted shortly after the injury **(a)**. Treatment consisted of autotransplantation of the developing mandibular right second premolar and orthodontic space closure **(b)**. The transplanted premolar received a composite resin build-up **(c)** and subsequently, the maxillary dentition was leveled **(d)**. Bracket placement was more apical than normally on the canine, extruding it during the leveling stage **(e)**. The incisal part was ground with diamond burs **(f,g)**. After appliance removal **(h)**, porcelain laminate veneers were made (by Dr Sverker Toreskog, Göteborg, Sweden) on the first premolar, canine, and the transplanted premolar. Both the crown morphology and the gingival contours resemble those of a natural dentition **(i to l)**.

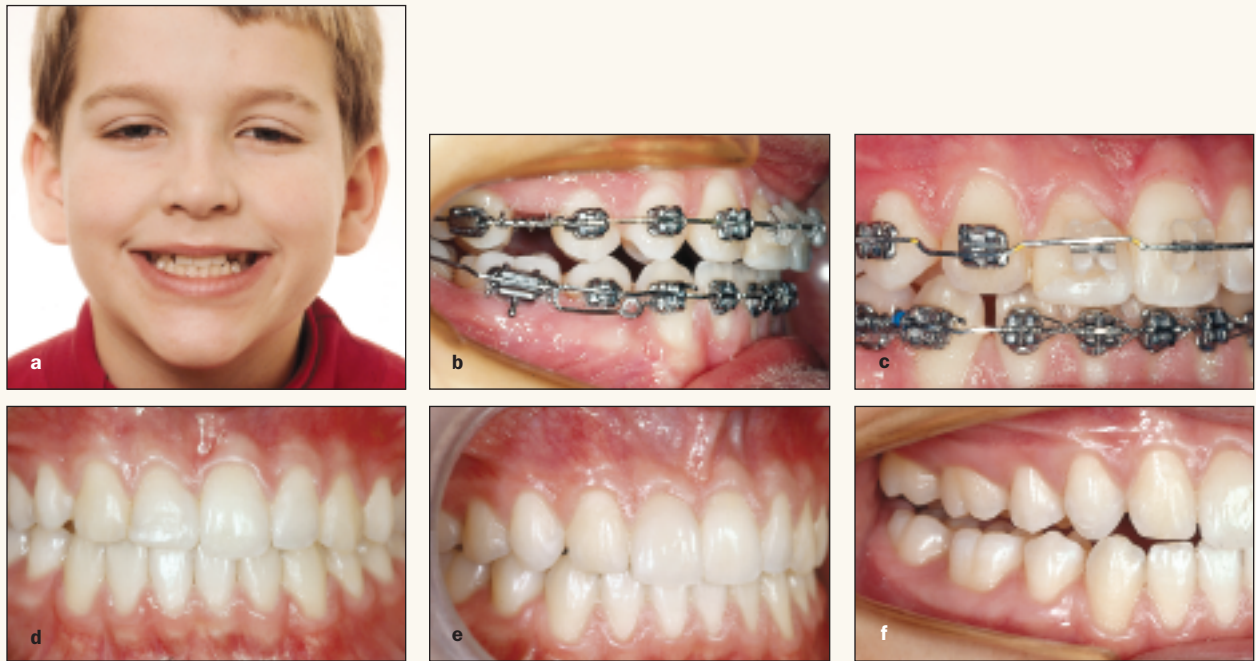


Fig 7 Young boy with missing maxillary right central incisor (a), treated with space closure (b,c). Intrusion of the first premolar and extrusion of the canine, and intrusion of the lateral incisor were made to improve the marginal gingival levels, using small step-bends in the archwires (c). After appliance removal, a porcelain veneer was made (Dr Sverker Toreskog) on the lateral incisor, whereas the ground canine and the first premolar received hybrid composite resin build-ups (d,e). Note that the build-up on the first premolar allowed a “canine”-protected occlusion on lateral excursions (f).



Fig 8 Modifying the bracket placement is more convenient than archwire step-bends when gingival margin leveling is desired in space-closure cases. Here, the porcelain bracket on the first premolar is placed in an incisal location, whereas the bracket on the canine is placed more apically than normal. This arrangement will automatically result in premolar intrusion and canine extrusion during the leveling phase of treatment.

should be a preferred mode of treatment. They concluded that the maintenance of a natural dentition is a valid treatment planning objective.

More recently, Robertsson and Mohlin¹³ re-evaluated 50 treated patients with agenesis of the maxillary lateral incisors (mean age 26 years, range from 18 to 55). The mean time after treatment was 7.1 years (range from 0.5 to 13.9 years). Thirty patients had received orthodontic space closure, and 20 had space opening for prosthetic replacement (porcelain bonded to gold and resin-bonded prostheses). These authors found (1) the space-closure

patients were more satisfied with the treatment result than the prosthesis patients; (2) there was no difference between the two groups in prevalence of signs and symptoms of TMD 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, does not impair TMJ function, and encourages periodontal health in comparison with prosthetic replacements.

As a final remark, it is possible to make a hybrid composite resin build-up on a first premolar that has been moved into the site of a canine, so that a “canine-protected” functional occlusion is achieved (Fig 7f). Whether or not this is of any advantage for the patient in the short or long run is not known at present, but will be interesting to study in years to come.

Conclusion

Recent improvements by orthodontists in tooth positioning and reshaping,¹⁻⁴ and progress in restorative treatment using individual tooth bleaching, hybrid composite build-ups, and thin porcelain veneers demonstrate that quality treatment can be obtained by combining proper space closure orthodontics and recent advances in esthetic dentistry.⁴

There is no available scientific or clinical evidence that substituting maxillary first premolars for canines should imply any notable compromise with regard to the esthetic outcome or to the long-term periodontal condition, or that such substitution should result in an inferior function compared with other treatment alternatives for missing lateral incisors or canines.

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