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Diagnosis and Treatment of Missing Upper Lateral Incisors Part 2

Abstract: The aim of this second article is to outline the management and treatment options for patients with missing upper lateral incisors at various stages of dental development. The joint orthodontic-restorative multidisciplinary teams are best placed to manage these challenging cases.

Clinical Relevance: There are various treatment options for the management of patients with absence of one or both lateral incisors. The orthodontic practitioner needs to be aware of the pros and cons of different options.

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In the first article we discussed the importance of detailed and thorough pre-treatment assessment of patients with missing lateral incisors. In this article we plan to outline the treatment options available for patients with missing lateral incisors. It is best to consider the options separately in the developing and permanent dentition. The benefits and limitations of each treatment modality need to be thoroughly discussed with patients and parents.

Management and treatment options

Deciduous/mixed dentition stage

It is recommended to maintain the deciduous lateral incisors for as long as possible in order to preserve the alveolar bone for possible future prosthetic replacement. Their dimensions could be maintained by composite resin additions.¹ However, if both permanent lateral incisors are absent, and the deciduous lateral incisors have a poor prognosis, they may be extracted. This allows the mesial eruption of the permanent canines into the permanent lateral incisor spaces (Figure 1).²

The secondary dentition

Irrespective of the type of treatment undertaken to address this clinical problem, orthodontic-restorative interdisciplinary planning and care is important in determining the end result as input from a single discipline may only be able to provide the patient with a compromised treatment plan, resulting in suboptimal care.^{3,4,5} The role of the orthodontist is to position the teeth for the best aesthetic and functional results. There are many factors involved in determining the best approach to an individual case and no one particular treatment option is suitable for all patients.

The main treatment options are as follows:

- To accept the situation, which is seldom suitable unless there are clear contra-indications to any form of appliance therapy or restorative treatment, eg poor oral hygiene or high caries rate.
- Restorative camouflage of permanent/deciduous teeth only. No active orthodontic intervention.
- Orthodontic space closure and substitution of the canine for the missing lateral incisor +/- adjunctive restorative or periodontal treatment.

Orthodontic space opening at the



Figure 1. Early loss of the deciduous lateral incisor has allowed mesial eruption of the permanent canines.

lateral incisor site for a prosthetic replacement by the following means:

- A tooth-supported restoration;
- A single tooth implant.

Treatment options in detail

Restorative camouflage of permanent or deciduous teeth

This involves composite resin additions to bulk out the central incisor and modification of the canine to close the space, or the resin build-up of a deciduous incisor, should it be deemed to be of good prognosis.⁶

Veneers may be employed to similar effect, although a diagnostic wax-up

should be undertaken to allow assessment of the aesthetic consequences of a restorative-only plan.

Substitution of the canine for the missing lateral incisor

The major advantage of this approach is the permanence of the finished result and the maintenance of alveolar bone height. There is no need for prostheses and the anterior teeth could be modified with minimally invasive restorations, such as composite resin or porcelain veneers, to enhance their appearance (Figure 2).⁷

This treatment may simply involve the extraction of the deciduous canine and lateral incisors at the appropriate time to encourage the more mesial eruption of the permanent canine adjacent to the central incisor. However, most cases would benefit from some form of orthodontic treatment to place the canines next to the central incisors.

Historically, it was thought that the canine-central incisor arrangement would reduce the upper arch size and lead to an inharmonious appearance, as well as denying the patient of a canine-protected occlusion during lateral mandibular movements.⁸ The lack of canine-protected occlusion was thought to have an adverse effect on the TMJ, but recent studies have disproved this theory and have found that orthodontic space closure does not impair TMJ function.⁹ The same study found that, overall, the patients treated with orthodontic space closure were more satisfied with the appearance of their teeth than those who had a prosthesis. The main complaint from those who had undergone orthodontic space closure was that the canines replacing the lateral incisors were too yellow. The authors have suggested that one of the reasons for the more modest levels of satisfaction with prosthetic replacement of the missing teeth may be the general impression of artificial in comparison with natural teeth. Another reason may be poor colour match and that this group contained more asymmetric cases. The level of specialist or general dentistry support will influence this outcome. It is important to mention that implant cases were not included in this study, and there are suggestions that patients who have received implants are more satisfied with this treatment than those who had undergone orthodontic space closure, and especially more satisfied than those who had a conventional prostheses replacement of the missing teeth.⁹

In terms of periodontal health, studies have found that those patients undergoing orthodontic space closure were significantly healthier than those who had a prosthetic replacement of the missing teeth, as the prostheses tended to accumulate more plaque and gave rise to increased locations



Figure 2. (a) Pre-treatment intra-oral photograph of a patient with missing upper lateral incisors. It was decided to modify the permanent canines with restorative techniques. (b) Post-restorative modifications of the upper permanent canines in the above patient.

with gingivitis.^{9,10}

Canine substitution requires fixed appliances in order to achieve accurate three dimensional controls. Proper bracket placement is important when treating patients with canine substitution. A canine bracket may be placed on the canine but inverted or, alternatively, a lateral incisor bracket may be placed on the canine (Figure 3). Both techniques apply varying degrees of palatal root torque (dependent upon bracket prescription) to the tooth in order to reduce the prominence of the canine eminence and help replicate the lateral root position.¹¹

The guide to bracket placement is the gingival margin and not the incisal edge or cusp tip. This will often lead to orthodontic extrusion of the canine. Orthodontic extrusion may result in premature contacts with the mandibular incisors. To prevent this premature contact, there is need for equilibration which, in effect, is the removal of the canine cuspal tip. This also promotes group function so that the upper first premolars are not loaded in isolation. McNeill and Joondeph¹² advise carrying out equilibration in three stages:

1. Reduce canine tooth material prior to appliance placement, using a diagnostic set-up as a guide. This establishes correct size and shape. Continue the process to the upper first premolars and the molars, if required.
2. Further equilibrate the teeth after appliance removal to establish group function as well as final recontouring of the upper canines.
3. Further functional equilibration after retention and settling.

During finishing, the width of the canine is reduced interproximally and is finally reshaped by resin additions to form the mesial and distal incisal corners of a lateral incisor.^{13,14} Other finishing procedures include applying further palatal root torque to the canines by archwire bending, mesio-buccal rotation bends on the upper first premolars and buccal root torque of these teeth to reduce non-working side contacts and improve aesthetics. Depending on the resting lip line, intrusion of



Figure 3. Canine brackets are inverted during orthodontic space closure.

the upper first premolars may be required to raise the level of their gingival margin to that of a canine.¹³ Prior to doing so, the patient must be aware that a subsequent addition on to the occlusal surface of the premolar will be required. Both direct and indirect techniques can be used.

Finally, vital tooth bleaching may be undertaken in order to shade match a naturally darker canine to the adjacent central incisor. If bleaching is performed, it is important that this should take place before the addition of any composite resin to camouflage an overtly caniniform tooth.

Space opening for replacement of the missing lateral incisor

When indicated, orthodontic appliances are used to create an appropriately sized space for a prosthetic replacement of the missing lateral incisor, which can be either a fixed or removable prosthesis. Fixed appliances are usually necessary to apply bodily tooth movements as well as three dimensional controls, particularly of the root apices (Figure 4).

In determining how much space should be created for an adequately sized lateral incisor space, three methods may be employed:

1. The use of the contra-lateral tooth width as a guide. If the contra-lateral tooth is diminutive in cases of unilateral hypodontia, a decision is necessary either to increase the width of the diminutive incisor, to match the reduced width (which may prevent later implant placement – see below), or to create a

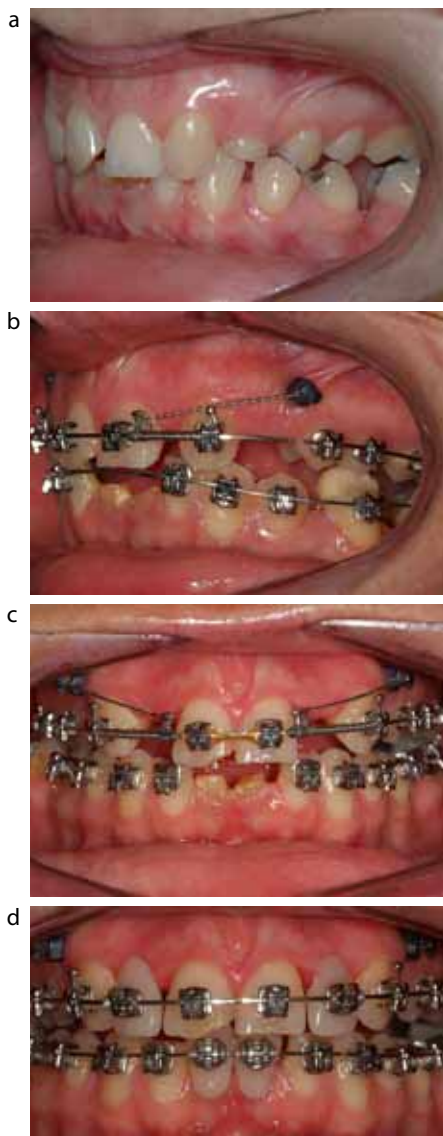


Figure 4. (a–d) A series of images where fixed appliances were used to recreate space for prosthetic lateral incisors. Temporary anchorage devices were used to support the anchorage during the distal movement of the canines. Glass-ionomer cement was also placed on the occlusal surfaces of the lower teeth in order to disclude the bite as the canine was corrected to a Class I.

more 'ideal' space and, therefore, asymmetry in the sizes of the two lateral incisors.

2. The 'golden proportion' states that the width of a lateral incisor should be approximately two-thirds of the central incisor.¹⁵ However, some researchers have failed to prove that this ratio commonly exists in the anterior maxillary teeth or is even considered as an ideal aesthetic standard.^{16–18}

3. Once the correct space has been created, a closed coil or prosthetic tooth attached to the archwire may be used to maintain the space.

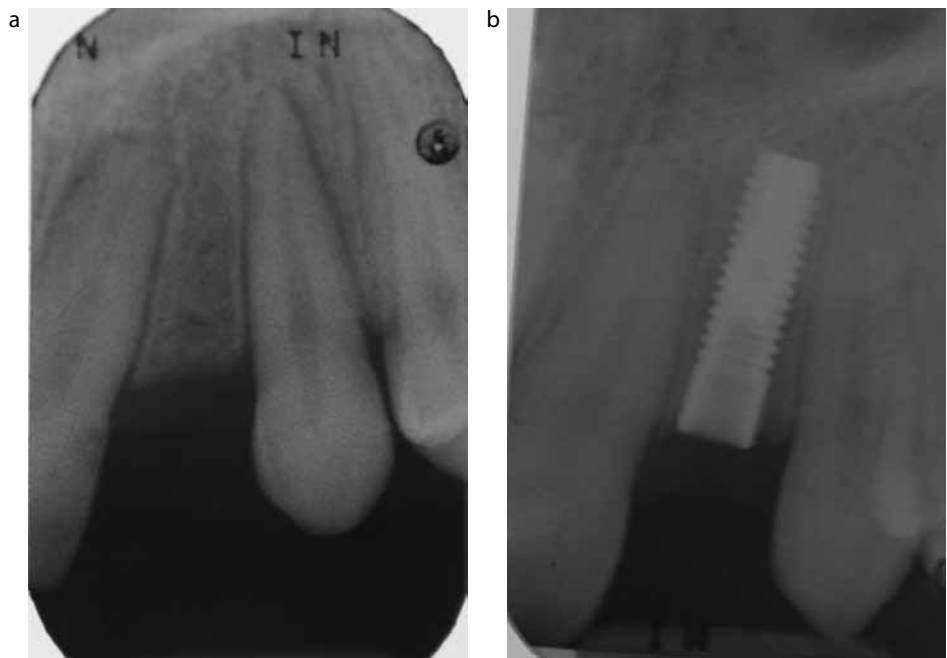


Figure 5. (a) Peri-apical radiograph demonstrating a reduced inter-radicular space for an implant. **(b)** Orthodontic treatment was repeated to upright both the canine and central roots to increase this space. A dental implant was successfully inserted.

Implant planning

Once the desired inter-coronal space has been created, it is sensible also to undertake inter-radicular space creation by ensuring root parallelism of the central incisor and the canine. Even if tooth-supported prosthesis is the intended immediate restoration, by ensuring root parallelism at this stage, the patient is free to consider implant treatment in the future without having to undergo another course of fixed appliance therapy (Figure 5).

Consideration should also be given to intruding the opposing lower canine to provide sufficient interocclusal space for the upper restoration. The minimum interocclusal space from the head of the implant to the occlusal plane to achieve a retentive and aesthetic restoration is about 5 mm.¹⁹ To ensure sufficient space for implant placement it is recommended that at least 6.5 mm of inter-coronal space and 5.7 mm of inter-radicular space is created between the upper central incisors and canines. The traditional width of an implant is 3.75 mm; the platform width is 4.0 mm. These measurements are important as the platform should sit interproximally between the central incisor and the canine at the crest of the alveolar bone. There should be at least 1 mm of space between the implant and the adjacent teeth. This space allows adequate healing and the development of the papilla. Therefore, if the contralateral incisor tooth is less than 6.5 mm, the provision of an implant may be contraindicated. If the space is narrow, consideration must be given to the use of a smaller diameter

implant,²⁰ though the long-term success of these has yet to be fully determined.

Prior to the removal of the orthodontic appliances, it is recommended that the patient is seen by the restorative dentist. This is to ensure that the clinician restoring the dentition is satisfied with tooth positioning, root angulations, inter-radicular and inter-occlusal spacing (Figure 6).

Given that osseointegrated implants behave similarly to ankylosed teeth,²¹ provision of implants in too young a patient is likely to result in infraocclusion of the implant-retained crown.²²

Post orthodontic retention

Following the removal of the orthodontic appliances, the occlusion should be retained. The choice of retention should be made based on the treatment plan and as to whether the incisor space was opened or closed. A pressure-formed retainer with a prosthetic tooth or a Hawley retainer incorporating stops mesial to the canine and distal to the central incisor and prosthetic tooth/teeth are advisable for space-opening cases. Removable retainers are often supplemented with a bonded retainer on the labial surface of the central incisors, especially where a pre-treatment median diastema was present or bilateral spaces have been recreated (Figure 7). In space closure cases, the tendency of the spaces to re-open after treatment could be overcome with properly finished occlusal contacts and long-term retention using bonded



Figure 6. Peri-apical radiograph to assess root positions taken near the end of orthodontic treatment.

retainers supplemented with removable retainers.⁶

In cases where space opening is followed by provision of a resin-bonded bridge, careful bridge design may contribute towards post-restorative retention. By incorporating twin abutments that cross the maxillary midline, relapse of a pre-treatment median diastema is minimized (Figure 8).

Post orthodontic restorative treatment

Final restorative treatment usually takes place once the gingival margins have stabilized and alveolar growth has been completed, this is particularly important when considering implant replacement of the missing teeth. With the exception of intermediate retainers carrying prosthetic teeth, which may be worn for several years, fixed restorations are preferable to removable partial dentures from the point of view of patient acceptability and dental health. The following are the options most commonly used to replace missing lateral incisors:

- Resin-retained adhesive bridges; and
- Implant-retained crowns.

Resin-retained adhesive bridges

Resin-retained bridges (RRB) are particularly suited to the restoration of a missing lateral incisor space, as seen previously (Figure 8).

Although their survival rates are lower than that of conventional fixed

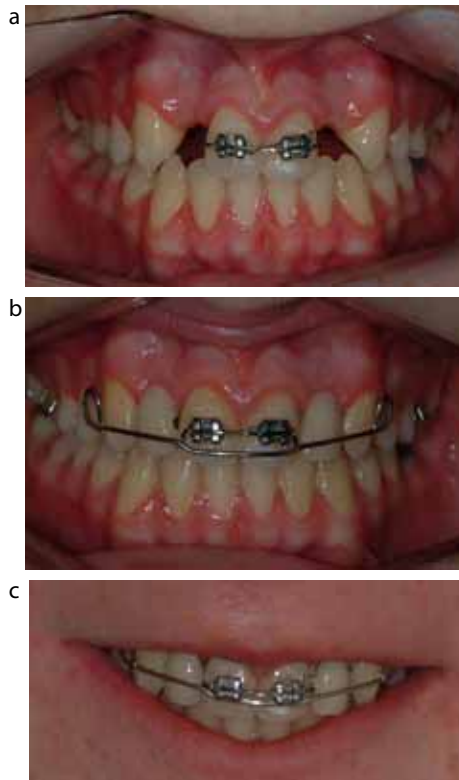


Figure 7. (a) Brackets are left on the labial surface of the upper central incisors. This prevents any space opening prior to the placement of resin-bonded bridges. (b, c) A modified Hawley retainer is fitted to maintain the positions of the lateral incisor spaces. Metal stops can be seen mesial and distal to the prosthetic teeth. These ensure that the retainer can be successfully worn even if the prosthetic teeth become detached.

bridgework, they remain as a technically simple and minimally invasive method of medium- to long-term management of edentulous anterior spacing.²³ Modern materials and bonding techniques have improved their survival rates of around 60% for a period of 10 years.^{24,25}

In their study of long-term survival characteristics of RBBs, Djemal *et al*²⁶ found that the consequences of their failure were rarely harmful to the abutment teeth and, when examined over a long period, the factors that affected their survival rates were:

- Area available for bonding;
- The inherent rigidity of the framework; and
- The demands placed by the design on the retention provided.

They commented that cantilever designs are relatively more successful. It has been suggested that the angulations of the central incisors should be more upright and vertical, as well as there being a need for minimal overbite, with just enough overlap to provide disclusion of the posterior teeth in protrusive function. The uprighting of proclined incisor teeth will minimize non-axial loading,

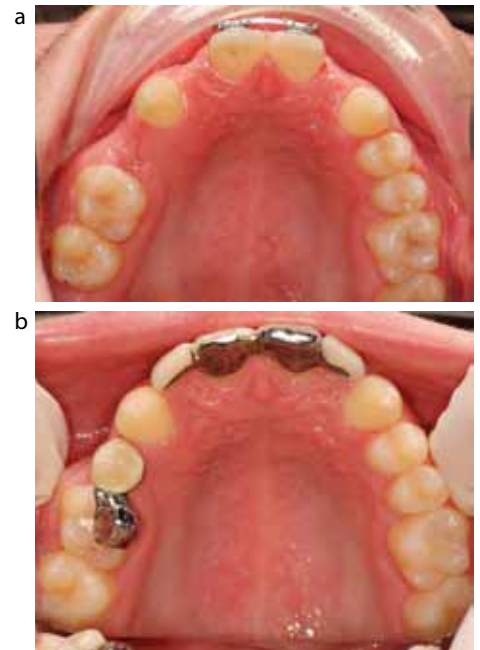


Figure 8. (a) The bonded labial retainer in position. (b) With the palatal surfaces free, a silicone impression may be taken of the upper dentition for construction of the resin-bonded bridgework.

potentially improving the prognosis of the prosthesis.

Patient satisfaction remains high with RBB, with one in ten having reservations about the appearance of the prosthesis.²⁵ The factors contributing to dissatisfaction were display of metal, greying caused by metal shine-through, loss of translucency, staining of the resin at the margins and the difficulty of matching pontics with young natural teeth.²³

Conventional full-preparation bridgework is now only reserved for patients where the supporting teeth are heavily restored, have had significant trauma, or have had root canal therapy.

Tooth movements associated with orthodontic space opening/redistribution are prone to relapse, therefore patients should be aware that, when an adhesive bridge debonds, space loss can be surprisingly rapid. They are advised to make a return appointment if they suspect that a bond failure has occurred.²³

Implant-retained crowns

An implant-retained crown is the long-term treatment of choice for the replacement of missing permanent lateral incisors (Figure 9).

A systemic review of the literature confirmed that their survival rates after a 5-year observation period was high²⁷ with figures of between 90–95% being reported.²⁸ Unfortunately, the maxillary bone quality is not as good as the mandible for implant placement



Figure 9. Implant-retained crown to replace missing upper lateral incisors.

and at times bone grafting may be necessary.

In cases where the canine has been distalized from the lateral incisor space, alveolar bone is created in the edentulous space and bone quality is improved due to appositional bone formation. Therefore, the edentulous ridge provides a much better site for either a bridge or an implant.^{19,29} It has been suggested that, in order to avoid the problems of alveolar bone atrophy and relapse, orthodontic treatment to open space for a prosthesis should not be carried out in a very young patient. By delaying treatment in this way, the patient is closer to the age of implant provision and there is therefore less time for atrophy of the recently developed ridge.²⁹ The same study found that proclination of incisors due to orthodontic space opening causes extra-axial stress on the implant and thinning of the cervical bone at implant sites. This could lead to gingival recession around the implant-supported crown margin and, potentially, implant failure.

Later loss of implants may also result from peri-implantitis, which may lead to longer term bone loss of the adjacent teeth or the buccal aspect of implant fixture.²⁷ Mechanical failure can occur due to fracture of the implant screw or superstructure.

It should also be borne in mind that an implant-retained crown may need to be replaced owing to a change in the relative positions of the implant and adjacent natural teeth. At least one paper has described these gradual changes taking place during adult years.³⁰ It is always important to make patients aware of the possible cost and maintenance implications of dental implants at the outset of treatment.¹⁹

Conclusion

A co-ordinated interdisciplinary care is essential to ensure that patients with missing lateral incisors achieve acceptable aesthetic and functional outcomes. Advances in restorative materials and techniques, together with orthodontics, can produce satisfactory long-term results for such patients.

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