When to Substitute a Missing Upper Lateral With a Canine: A Simplified Approach

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Abstract

Introduction: The upper lateral incisor is the most commonly missing tooth in the anterior segment. It leads to esthetic and functional imbalance for the patients. The ideal solution is the one that is most conservative and which fulfills the functional and esthetic needs of the concerned individual. Canine substitution is evolving to be the treatment of choice in most of the cases, because of its various advantages. These are special cases that need more time and effort from the clinicians due to space discrepancy in the upper and lower arches, along with the presentation of individual malocclusion.

Aims and Objectives: Malocclusion occurring due to missing laterals is more complex, needing more time and effort from the clinicians because of space discrepancy, esthetic compromise, and individual presentation of the malocclusion. An attempt has been made in this article to review, evaluate, and tabulate the important factors for the convenience of clinicians.

Method: All articles related to canine substitution were searched in the electronic database PubMed, and the important factors influencing the decision were reviewed. After careful evaluation, the checklist was evolved.

Result: The malocclusions in which canine substitution is the treatment of choice are indicated in the tabular form for the convenience of clinicians. Specific treatment-planning considerations and biomechanics that can lead to an efficient and long-lasting result are also discussed.

Conclusion: The need of the hour is an evidence-based approach, along with a well-designed prospective randomized control trial to understand the importance of each factor influencing these cases. Until that time, giving the available information in a simplified way can be a quality approach to these cases.

Keywords
Congenitally missing teeth, hypodontia, canine substitution, dental agenesis, missing upper lateral incisors

Received: 26 September 2020; Revised: 22 November 2020; Accepted: 23 November 2020

Hypodontia is a common dental anomaly and involves one or more teeth of the individual. The overall prevalence of hypodontia is 6.4%, with the highest number of cases seen in Africa (13.4%). The region is followed by Europe (7%), Asia (6.3), and Australia (6.3%), with lowest prevalence in North America (5%) and Latin America (4.4%). Females are more commonly affected than males. The commonly affected teeth are the maxillary lateral incisors, mandibular second premolars, and the maxillary second premolars. Etiological factors in missing maxillary laterals include familial tendency, with one or more point mutations in a closely linked polygenetic system, most often transmitted in an autosomal dominant pattern with incomplete penetrance and variable expressibility.

Missing maxillary lateral incisors, a type of true partial anodontia, is also associated with other dental anomalies, such as agenesis of other permanent teeth, increased occurrence of microdontia of the maxillary lateral incisor of the contralateral side, palatal displacement of canines, and distal angulation of mandibular second premolars. Being part of anterior dentition, missing maxillary laterals lead to functional imbalance and esthetic disability, which can have a negative psychological impact. Options in treating such patients include either the possibility of orthodontic space closure or a combination of orthodontic space opening and replacement of the missing tooth. Treatment should be planned as conservatively as possible while fulfilling the patient’s aesthetic and functional needs. The choice between...
the two has been a controversial topic of discussion. However, because of the superiority of periodontal health, lack of long-term biological and technical considerations, and possibility of early completion of definitive treatment, canine substitution can be the treatment of choice whenever possible. With the number of variables involved, it may be beneficial to have a simplified approach for selecting this treatment modality.

All the publications related to canine substitution were searched in the electronic search engine “PubMed” using various keywords related to the topic. The relevant articles were reviewed to understand the factors affecting the decision of substituting the canine for the missing maxillary lateral incisor. An attempt is made in this article to evolve a straightforward checklist of all the key factors that help clinicians in the selection of space closure as a treatment modality. The specific mechanics involved during the orthodontic treatment of these cases are also discussed for the same reason.

Diagnosis of a missing lateral incisor needs to be confirmed with the interpretation of various diagnostic aids, which include case history, clinical examination, photographs, intra-oral peri-apical (IOPA) X-rays, study models, and orthopantomographs (OPG) along with the addition of supplementary aids, like cone-beam computed tomography (CBCT). The patient could present with either of the following cases:

1. Over-retained deciduous lateral incisor and missing permanent lateral incisor: In this case, extraction of the deciduous tooth should be planned to address the patient’s esthetic and psychological needs for the time being, to guide the eruption of the canine adjacent to the central incisor and to maintain the alveolar ridge thickness.
2. Missing both the deciduous and permanent upper lateral incisors.

   a. **Patient in primary or early mixed dentition:**
   If an adequate amount of space is present, a temporary prosthesis can be fitted till the final plan is executed.

   b. **Late mixed dentition or permanent dentition:**
   Complete treatment planning with a discussion about all three replacement options should be done. Space closure can be a better option for patients who are in the mixed-dentition stage, since the waiting period needed for implants can be avoided.

The decision to either open the space or close the space for canine substitution also depends on the various factors such as facial profile, type of skeletal and dental malocclusion, age, cost affordability, treatment time considerations, canine position, color balance, and its anatomy. The following are the guidelines that can be helpful in the decision-making process.

1. **Facial profile:** A balanced, relatively straight profile is ideal for canine replacement. However, dentoalveolar protrusion leading to a convex profile or a mildly inharmonious concave profile may also be acceptable. For a severely convex or concave profile, a comprehensive plan needs to be evolved keeping in mind the specific skeletal correction needed for a particular patient, along with the missing lateral-incisor treatment.

2. **Malocclusion**

   a. **Anteroposterior discrepancy:** Angle’s class I with crowding, dentoalveolar protrusion in the lower arch and Angle’s class II malocclusion are the types of cases in which stable occlusion can be achieved at the end of the treatment with canine substitution. Angle’s class III with dentoalveolar discrepancy less than 5 mm can also be considered for canine substitution.

   b. **Vertical and transverse discrepancy:** In patients with maxillary vertical excess, canine substitution is possible, along with added considerations to correct the gingival levels of the substituted tooth because of increased visibility upon smiling.

3. **Age:** Age is not a contraindication for canine substitution once the patient is ready for definitive treatment. In fact, it can be an advantage to do the same in a patient in the growing age, since the patient does not have to wait for their vertical growth to be completed, which needs to be considered when one opts for implant or prosthetic replacement.

4. **Canine specifications:** Canine substitution would be ideal if the canine that needs to be recontoured as a lateral incisor is flat labially, is the same color as the central incisor, is narrow in mid-crown width buccolingually, and is narrow at the cemento-enamel junction, since this would limit the amount of mesiodistal reduction possible. In cases where there is a large difference in color or size, reduction in the inciso-gingival and mesiodistal dimensions, flattening of the labial surface, steepening of the lingual convexity, use of bleaching, composite bonding, or veneering to mimic the replaced tooth can be considered. Similarly, the dimensions of the premolar can be increased mesiodistally for it to replace the canine.

5. **Cost of treatment:** Canine substitution is the most cost-effective treatment modality, since the clinician would be using the patient’s own tooth as a replacement and the extra cost of a prosthetic replacement with or without an implant is avoided.

After a critical analysis of these influencing factors, the following checklist has been formulated so that it is easier for clinicians to decide whether canine substitution is the right choice for their patients (Table 1). A systematic approach to decision making has been presented in the form of a flowchart (Figure 1).
Table 1. Checklist for Selection of Cases with Missing Lateral Incisors for Orthodontic Canine Substitution as a Definitive Treatment Option.

| S. No. | Evaluation Criteria | Favorable Case for Canine Substitution | Comment |
|--------|---------------------|----------------------------------------|---------|
| 1      | Facial profile      |                                        |         |
|        | a. Straight to mildly convex | Yes |         |
|        | b. Convex profile (severe) | Variable | Comprehensive evaluation for skeletal correction | |
|        | c. Concave profile— mild | Yes |         |
|        | d. Concave profile— moderate to severe | Variable | Comprehensive evaluation for skeletal correction | |
| 2      | Malocclusion        |                                        |         |
|        | Angle’s class I malocclusion | Yes |         |
|        | Angle’s class II crowding or severe proclination | Yes |         |
|        | Angle’s class II— nonextraction | Yes |         |
|        | Angle’s class III (<5 mm discrepancy) | Yes | Comprehensive evaluation for correction of class III skeletal relationship |
|        | Angle’s class III with more than 5 mm discrepancy | Variable | Comprehensive evaluation for correction of class III skeletal relationship |
| 3      | Age                 |                                        |         |
|        | Growing age         | Yes | Comprehensive evaluation for malocclusion and skeletal discrepancy, if any |
|        | Adult               | Yes | Comprehensive evaluation for malocclusion and skeletal discrepancy, if any |
| 4      | Cost-effective treatment | Cost-effectiveness compared to prosthetic and/or implant options | Yes |         |

Table 1 Continued

| S. No. | Evaluation Criteria | Favorable Case for Canine Substitution | Comment |
|--------|---------------------|----------------------------------------|---------|
| 5      | Canine specifications | Canine shows compatible color, shape, and prominence | Yes | Comprehensive rehabilitation |
|        | Color-incompatible | Yes | Evaluate for prosthetic rehabilitation |

Figure 1. Flow Chart Showing Evaluation of Facial Characteristics and Malocclusion to Determine Comprehensive Treatment Planning for Canine Substitution in Patients With Missing Lateral Incisors.

Orthodontic Considerations

The orthodontist plays a key role in managing the treatment of missing laterals. Clinical considerations other than those discussed earlier are divided into two parts: treatment planning and mechanics.

1. **Diagnosis and treatment planning:** Evaluation of the amount of space needed for the missing lateral incisor is the most important step in all the available options. Anterior-tooth-size excess, which is typical in canine substitution cases, also needs to be evaluated to plan the amount of canine reduction. The following factors can be taken as guidelines for creating space for the lateral.

   a. **Golden proportions:** This method is a measurement of esthetics which can be utilized when a canine is used to replace a lateral incisor. It states that beginning with the central incisor, each tooth should be 61.8% larger than the tooth distal to it. The apparent widths of the maxillary anterior teeth, upon smiling, and their actual
mesiodistal width differ because of the curvature of the dental arch. For the best results, the apparent width of the lateral incisor should be approximately 62% of that of the central incisor, and a similar guideline is followed for a canine and a premolar.18

b. Usage of the contralateral lateral incisor as a guide, if present, and assessing whether it is without any shape anomaly.

c. **Bolton analysis:** Bolton has given a formula to measure and compare the mesiodistal widths of upper and lower teeth to achieve an ideal occlusal relationship. The anterior ratio can be used to mathematically calculate the excess in the upper anterior region.22

d. **Diagnostic setups:** One can have a plaster setup and/or a pictorial setup to identify tooth-size problems, which can help one simulate the final planned occlusion and smile. In Kesling’s diagnostic setup, individual teeth and their associated processes are sectioned off from the patient’s model and replaced in the desired future position. The setup simulates future tooth positions so that the end result can be visualized. It also helps in patient motivation, which can in turn help improve their cooperation during the treatment period.23 Similarly, a pictorial setup can be established with pictures of the patient smiling or speaking, to evaluate the current status of the patient’s gingiva and teeth, and it could also help the clinician simulate future positions of the patient’s teeth, gingiva, and smile. It can be done by hand on acetate tracing paper, or by means of a computer software.14,24

2. **Mechanics:** Correct bracket positioning, keeping in mind the future position of the individual tooth, can be helpful in reducing the overall treatment time. The canine bracket should be placed in such a way that it would extrude the canine into the lateral incisor’s vertical ginvival height.9,18 For getting the ginvival levels correct, one needs to keep the ginvival shape and height in the correct order. Ideally, the ginvival shape of the maxillary central incisors should be a symmetric semicircle, and their ginvival height should be at the same level as the maxillary canine. The lateral incisor should be about 1.5 mm lower than the central incisor, and its ginvival zenith should coincide with the latter’s longitudinal axis. The shape of the ginviva for the central incisor and the canine should be more elliptical and oriented more distally to the long axis of the tooth. Crown-lengthening procedures and periodontal surgeries can be performed when necessary. Additionally, full uprighting of the mesially displaced canine should be done through checking the roots of the canines, so that a slight mesial tilt can be provided effectively for its imitation of the lateral incisor. The optimal torque angulation that is present in the lateral incisors, canine, and premolars needs to be expressed for a good esthetic result. For the stability of the result achieved, the established group function occlusion should be checked well and long-term retention should be provided to the patient.14,24

Every case is unique in its own way in orthodontic practice. In patients with missing lateral incisors, the selection of a suitable treatment modality has always been a challenge. These cases need information which differs from routine orthodontic treatment protocol. The advantage of making a ready-to-use checklist is the gathering of all case-specific information under one roof and in turn reduction of the time needed for the clinician to decide on a treatment plan. The mechanics specifically used for replacing a lateral incisor with a canine and a canine with a premolar are also discussed for the same reason. The need of the hour is an evidence-based approach, along with a well-designed prospective randomized control trial, for understanding the importance of each factor discussed in this article. Treatment of missing laterals needs a thorough discussion with the patient and the family members to understand their expectations, so that the clinician can guide them correctly as per the factors influencing the situation. Above all, an interdisciplinary approach is the best way and should always be considered during the treatment planning stage in missing-lateral cases.

**Declaration of Conflicting Interests**

The author declared the following potential conflicts of interest with respect to the research, authorship, and/or publication of this article: The author declares that there is no conflict of interest.

**Funding**

The author received no financial support for the research, authorship, and/or publication of this article.

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