Patients with congenitally missing maxillary lateral incisors may seek treatment from an orthodontist for several reasons: unpleasant smile, dental arch disharmony, and midline deviations are among the most frequent complaints. Orthodontists and prosthodontists have raised important questions about the esthetics, occlusion, periodontal health, and psychological conditions noted in these patients. The decision to open lateral incisor spaces for prosthetics or close spaces by mesial movement of the canines requires a careful diagnosis and comprehensive multidisciplinary treatment planning. The purpose of this article is to present a diagnostic protocol to assist in the decision-making process, while analyzing patients with absent maxillary lateral incisors. The basis for a sound diagnosis and an effective treatment plan resides in careful consideration of the facial and dental characteristics of each patient. All information gathered during the clinical examination should be added to data obtained with other diagnostic tools, such as cephalometric analysis and orthodontic waxups, to achieve the treatment option that best suits the patient’s expectations.


Should the spaces of absent maxillary lateral incisors be opened for prostheses or closed by mesial movement of the canines? Clinicians who face this decision must be prepared to work with individuals who have high expectations. The demand for orthodontic treatment in these patients is elevated because this condition has a powerful influence on dental and facial esthetics.

Since a significant number of these orthodontic patients are adolescents, anxiety and uncertainty are typically present. Frequently, both patients and parents want a fast and easy solution, which may not be possible. These patients often are more interested in the esthetics of their smiles rather than in having optimal occlusions.

The unbalanced smile, dental asymmetry, and facial disharmony frequently associated with individuals missing maxillary lateral incisors are complex problems with multiple treatment options and no immediate solutions. Inadequate treatment planning and poor communication between the people involved in the correction of such problems may cause an increased level of frustration in patients and their families. It is the responsibility of the orthodontist to provide a functional and healthy occlusion, while improving esthetics within the limitations of each case. Therefore, a diagnostic protocol providing a meticulous and consistent method of evaluation for patients with absent maxillary lateral incisors may facilitate treatment planning and the communication between professionals, patients, and families.
LITERATURE REVIEW

Patients with congenitally missing teeth frequently seek out orthodontic care. Such a condition creates an imbalance in maxillary and mandibular dental arch length that complicates diagnosis and treatment planning. The frequency of congenitally missing or peg-shaped maxillary lateral incisors varies significantly among different populations. Most reports in the literature show a variance between 1% and 3% for absent lateral incisors and between 2% and 5% for peg-shaped teeth. Agenesis of both maxillary lateral incisors is more frequently seen than agenesis of only 1 and it is slightly more common in females. When facing such cases, the clinician must decide between providing space for future prosthetic work or closing the spaces anteriorly, followed by reshaping of the canines to mimic lateral incisors.

The controversy about whether to open or close missing lateral spaces has long been discussed in the literature. An adequate treatment plan must evaluate potential effects of orthodontic therapy on patient facial esthetics and combine such information with other factors, such as the shape, size, and position of the canines, as well as the type of malocclusion. Appropriate orthodontic mechanics must be selected to allow the treatment goals to be achieved.

From the early days of orthodontics as a dental specialty to the 1950s, a Class I Angle canine relationship was considered a primary goal of any orthodontic treatment. Placing a canine anteriorly to substitute missing maxillary lateral incisors was believed to reduce the size of the maxillary arch, producing a disharmonious smile, and compromise facial balance. However, during the second half of the 20th century, space closure became a more popular treatment choice due to the concerns regarding the esthetics of prostheses and related periodontal health problems. Advocates of space opening have pointed to compromised dental esthetics, high relapse tendency, and lack of a canine protected occlusion as the major disadvantages of space closure.

Strang and Thompson were some of the first authors to evaluate clinical results in cases of congenitally missing maxillary lateral incisors; their reports indicated that the most satisfactory results were achieved when repositioned maxillary canines closed the anterior spaces. Tuverton pointed out the permanence of the finished results, the elimination of any associated risks of prosthetic appliances, the better esthetic outcomes, and the functional improvements as some advantages of space closure. No significant differences in the prevalence of signs and symptoms of temporomandibular dysfunction (TMD) were noticed between patients treated with either approach. The degree of esthetic improvement varies according to the shape and position of the canines and the clinician's ability to make these teeth resemble and function as lateral incisors. An inadequate color contrast between canines and central incisors and/or an ineffective canine recontouring could lead to an unpleasant esthetic result.

Long-term complications from the enamel reduction that must take place to “transform” canines into lateral incisors have been mentioned as a negative outcome of space closure. However, both short-term histologic investigations and long-term studies have shown that significant enamel grinding of newly erupted teeth can be performed without major discomfort to the patient and with minor or no clinical and radiographic reactions, as long as adequate water cooling is implemented and the ground facets are left to self-cleansing.

The type of malocclusion seen in the patient with congenitally missing maxillary lateral incisors may also influence the decision about whether to open or close anterior spaces. When mandibular arch extractions are indicated to alleviate crowding, to camouflage a moderate skeletal Class III malocclusion, or to correct a molar Class II relationship, space closure should be the treatment of choice. Although some clinicians advise against closing missing lateral incisor spaces because they consider achieving a canine-guided occlusion a mandatory
orthodontic treatment goal, others have found no significant differences in adequacy of occlusal function between groups with space opening and those with mesial movement of the canines. Lower levels of plaque accumulation, gingival inflammation, and periodontal pockets are other reported advantages of space closure.

The recent advances in osseointegrated implants associated with modern prosthetic alternatives and the return of the nonextraction trend in orthodontics have increased the popularity of space opening to replace the missing lateral incisor. Tooth structure preservation and alveolar bone maintenance associated with adequate esthetics and function have been pointed to as the advantages of using an implant to replace an absent maxillary lateral incisor. Kokich and co-authors have proposed detailed guidelines to optimize the results obtained from the interaction of orthodontics, periodontics, and prostodontics when spaces are opened for implants and prosthetic substitution of absent maxillary lateral incisors.

Opening or closing the remaining anterior spaces is the diagnostic decision, and either choice must account for some compromise. The question to be answered is: Which compromise represents the best cost/benefit to the patient, both functionally and esthetically? The aim of this article is to present a diagnostic protocol listing variables to be analyzed before deciding whether to open spaces for protheses or to close them by repositioning the canines and central incisors in patients with congenitally absent maxillary lateral incisors.

**DIAGNOSTIC PROTOCOL**

**Facial aspects**

**Profile evaluation.** A careful examination must be performed to collect all information needed for achieving the best treatment plan for each patient. The treatment approach implemented to solve the problem of missing lateral incisors may influence a patient’s soft tissue profile. A significant increase in the nasolabial angle and a more retrusive upper lip as a result of retraction of the maxillary central incisors were noted in cases in which bilateral spaces were closed.

A convex profile is usually related to Class II malocclusions. These cases generally have a greater indication for space closure, especially when there is little growth potential, and overjet reduction by retraction of the central incisors will be used to camouflage a skeletal problem. When protrusive maxillary and mandibular incisors are present, mandibular arch extractions may be indicated (Fig 1).

Appropriate orthodontic mechanics could lead to good results in patients with straight profiles by either opening or closing the remaining spaces of congenitally absent lateral incisors. Therefore, other variables have a higher diagnostic value in patients with these facial characteristics.

Patients with concave profiles represent a greater challenge when deciding whether or not to open space for prosthetic substitution of missing maxillary lateral incisors. These patients usually present an edge-to-edge or a negative overjet. Skeletally, midface deficiency and/or mandibular prognathism are observed. Closing anterior spaces in patients with such facial characteristics may increase profile concavity and maximize the maxillary deficiency. Thus, space opening and subsequent prosthetic reconstruction should be the treatment implemented because it would increase upper lip support, thus camouflaging the skeletal Class III appearance (Fig 2). A multidisciplinary diagnosis is even more important in these cases, and orthognathic surgery may be indicated to obtain a satisfactory facial outcome.

**Smile line.** Uncontrolled retraction of the anterior teeth could lead to excessively upright maxillary incisors, increasing the patient’s overbite and gummy smile. When the patient presents with a high smile line, the demand on canine modification and color matching is enhanced. The difference between labial gingival contours of canines adjacent to central incisors becomes more apparent, and the clinician must be aware of this.
Fig 1  (a to f) Pretreatment photographs. (g to l) Posttreatment photographs.
Fig 2  Absent lateral incisor spaces opened to increase upper lip support. (a to e) Pretreatment photographs and (f to j) immediately posttreatment.
Thus, obtaining a pleasant smile line with space closure in patients with missing maxillary lateral incisors that also have an excessively gummy smile may be significantly more challenging than if spaces are opened for a prosthesis (Fig 3).

**Nasolabial angle.** The position, size, and shape of the nose are other important aspects to be analyzed. Orthodontists are not able to alter noses, but their relative appearance can be influenced by some orthodontic procedures that directly affect the position of the lips. Excessive upper lip retraction may increase the nasolabial angle, leading to a “pseudo-increased” nose. Mandibular incisor position is also relevant in these cases, because they may direct the extraction decision during treatment planning.

**Canine position.** Canine position and its root angulation may be a complicating factor when the clinician decides to open space for a prosthesis. In patients with congenitally missing maxillary lateral incisors, the canines frequently show a mesial pattern of eruption, achieving their final position adjacent and parallel to the central incisors. Such a condition favors using the canine as a substitute for the lateral incisor. Space opening would be facilitated in cases where the eruption pattern is not significantly changed and the canine is mesially inclined, with its crown next to the central incisor and its root adjacent to the premolar root.

Recent advances in osseointegrated implants have increased the popularity of space opening, especially because there have been signs of greater patient satisfaction with the anterior esthetics obtained with this treatment approach. The ideal orthodontic preparation of an adolescent patient who will receive an anterior implant to substitute for a missing lateral incisor requires the implementation of procedures to stimulate canine eruption adjacent to the permanent central incisor. The distal movement of the canine after its eruption will result in an appropriate alveolar bone ridge for implant placement.

**Dental and functional aspects**

The diagnostic variables discussed within this article should not be considered separately. A responsible and adequate solution should be supported by other important information; the dental and functional aspects observed at the initial clinical examination are as important as the esthetic considerations.

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*Fig 3 (a) A high smile line determines the visibility of the canines and central incisors. (b) Space opening is preferred in such cases.*
Canine color. The presence of an adequate color balance among the maxillary anterior teeth has a dramatic impact on the patient’s esthetic perception.\textsuperscript{28} Since the canines are usually darker than lateral and central incisors, orthodontists must pay careful attention to the severity of this color discrepancy when deciding between opening or closing missing maxillary lateral spaces (Fig 4). The decrease in translucency and the darker canine color resulting from incisal edge recontouring, as well as the alteration in canine color degradation due to labial enamel reduction, may increase the color difference between canines and central incisors.\textsuperscript{17} Robertsson and Mohlin\textsuperscript{12} reported that the lack of color balance between maxillary canines and the adjacent teeth was a major cause of patient dissatisfaction among those who received orthodontic treatment to close absent lateral incisor spaces. Therefore, in cases with a significant color difference, leaving the canines in their usual position may be the most appropriate treatment approach. When other factors have a greater value in the decision-making process and space closure is applied, either in-office or at-home bleaching procedures could be implemented to improve the appearance of the canines in relation to the central incisors.\textsuperscript{26}

Canine shape. Some canines have such a unique appearance that even an experienced prosthodontist would have difficulty reshaping them to an acceptable lateral incisor anatomy. They appear in different forms, from conical to trapezoidal, and recontouring can be performed only within certain limits.\textsuperscript{29} When the canine shape imposes severe limitations for reshaping, the esthetic result may be quite unpleasant to the patient, leading the clinician to consider space opening to obtain better esthetics.

Multiple congenitally missing teeth. The combination of absent maxillary lateral incisors with other congenitally missing teeth is not uncommon; the case complexity increases when this takes place. Orthodontic waxups to evaluate different treatment options certainly provide important information for treatment planning. A multidisciplinary approach is usually required, and the patient’s expectations must be considered while deciding upon the treatment approach.

Unilateral absence. Obtaining adequate esthetics with space closure in patients with unilateral absence of a maxillary lateral incisor is a challenging clinical task. A careful comparison between the canine shape, color, and size on the missing lateral side and on the contralateral incisor will determine if space closure would result in a significant esthetic compromise, which could contraindicate its implementation. Tuverson\textsuperscript{11} suggested that in unilateral absence cases, better esthetic results are seen when space is opened for a prosthesis (Fig 5) or when the existing lateral incisor is extracted and both canines
Fig 5  Orthodontic preparation for a single-tooth implant in a patient with a unilateral absence of a maxillary lateral incisor.  (a to f) Pretreatment.  (g to k) 10 years postretention and 5 years after implant placement.
Fig 6  Peg-shaped lateral incisor extraction, followed by anterior movement of the canines. (a to i) Initial patient records. (j to q) Photographs at 5 years postretention.
are placed anteriorly. Contralateral incisor extraction may also facilitate the maintenance of midline symmetry, contributing to better dental harmony. When the present lateral incisor is a peg-shaped tooth with a thin and short root, the prognosis for a prosthetic restoration may be questionable and its extraction should be considered as the treatment of choice (Fig 6).

Cleft lip and palate patients. Patients with unilateral clefts have a high incidence of missing teeth at or close to the cleft. Since there is no bone continuity to support the transverse dimension of the arch, maintaining space for a rigid prosthetic restoration to increase treatment stability is recommended. Most cases will require a bone graft during the orthodontic therapy.
Functional occlusion. A canine-protected occlusion will not be achieved when the canines are moved mesially. If the clinician strongly believes that such a characteristic is mandatory, space opening must be the treatment of choice. However, a functioning occlusion can be obtained with lateral group function after space closure. In these cases, careful occlusal equilibration is required to decrease the risks of potential occlusal overloading. Reduction of canine incisal edges to eliminate premature contacts with the mandibular incisors and grinding of the maxillary first premolars to limit cross-tooth balancing interferences have been suggested to improve occlusal stability.
Periodontal considerations

**Alveolar bone width.** Canines usually have a wide and long root, while the lateral incisor region frequently presents with a narrow alveolar bone area, reflecting the tooth’s usual root shape. The combination of a wide canine root and narrow alveolar ridge in the lateral incisor region may indicate insufficient bone to allow adequate movement of the canine. Esthetically, since the bulk of the canine root is greater than that of a lateral incisor root, the normal depression over the lateral incisor root is not seen. When such situations are easily noticed before treatment, space opening would lead to better aesthetic results and diminished risk of developing future periodontal problems, such as gingival dehiscence.

**Gingival height.** The ideal anterior gingival architecture has the central incisor and canine margins at the same level, while the lateral incisor gingival contour is approximately 1 mm more incisal. Therefore, space closure may result in an esthetic anterior gingival anatomy, especially when combined with a high smile line. The clinician should be aware of such possible problems before deciding on the most suitable treatment approach. Canine extrusion and first premolar intrusion may be used to achieve ideal gingival esthetics in cases where space closure is implemented. Extrusion of the canines will require grinding of the cusp tips, which must be performed to mimic the lateral incisor shape (Fig 7). First premolar intrusion may demand composite buildups to obtain proper lateral excursions since these teeth will be functioning in the canine positions.

**CONCLUSION**

This article reviewed steps needed for a careful diagnosis in patients with congenitally missing maxillary lateral incisors. Many variables were presented, none of which should be considered separately. A meticulous evaluation of the data gathered from each topic discussed, combined with a realistic assessment of the patient expectations, should guide the orthodontist while treatment planning such cases. This protocol could also facilitate the communication with other multidisciplinary team members, as well as with the patient and the patient’s family.

The decision to open or to close absent maxillary lateral incisor spaces remains a challenging task for most orthodontists. The clinician must balance the advantage of avoiding long-term restorations with the aesthetic limitations imposed by using canines as lateral incisor substitutes. All efforts from the professionals involved should focus on minimizing the treatment margins of error by developing good coordination among the multidisciplinary team members, capitalizing on their experience, and consequently achieving an individualized treatment plan that efficiently meets the patient’s expectations.

**REFERENCES**