Annals of Medicine and Medical Sciences (AMMS)
Volume 04, 2025, *Page No.: 1236 to 1244*
Available at: *http://ammspub.com*

Case Report

OPEN ACCESS

Managing Maxillary Lateral Incisor Agenesis: Insights from Clinical Cases and Literature

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Abstract

The agenesis of maxillary lateral incisors is a common dental anomaly that often presents aesthetic and functional challenges for patients and orthodontists. Patients are generally faced with two main treatment options: orthodontic space closure with canine substitution or space opening followed by prosthetic replacement. Both approaches aim to achieve satisfactory functional and aesthetic outcomes. While both options can provide acceptable results, their indications and outcomes differ depending on the individual characteristics of each patient and long-term considerations. This article highlights, through clinical cases, the importance of a multidisciplinary approach in treatment planning for cases of lateral incisor agenesis, ensuring that the unique needs of each patient are addressed to achieve the best possible short- and long-term outcomes.

Keywords: ***agenesis, maxillary lateral incisor, space closure, canine substitution, prosthetic replacement, multidisciplinary approach.***

Introduction

Dental agenesis is one of the most common developmental dental anomalies in humans, with a prevalence of approximately 2% of the population [1], and accounts for about 20% of all missing teeth [2]. Dental agenesis is generally bilateral and occurs symmetrically. There is an exception concerning the maxillary lateral incisors, which are often absent unilaterally, with the left side being more affected than the right [3]. Indeed, when one lateral incisor is absent, its counterpart typically presents with a shape or size anomaly [4].

A successful and thus satisfying dental treatment is always the goal for both patients and dental practitioners. Imagine a patient consulting for agenesis of the maxillary lateral incisors. The patient is then faced with the possibility of closing the spaces with canine substitution or opening the spaces for an implant or a prosthetic restoration (such as a bridge). All options are possible, but the patient is curious to know which is more aesthetic in the short and long term. What should be said to this patient? Are there established studies that compare the aesthetic outcomes of different methods for managing agenesis of lateral incisors ? Are there certain indications for one type of treatment plan over another?

Considering malocclusion, the smile line, and the aesthetics of natural teeth, this article aims to provide answers to these questions through a literature review while presenting examples of therapeutic approaches.

The orthodontic approach: space closure and canine substitution (clinical case no1)

According to various authors, this technique is the most conservative and favourable approach if a patient meets certain requirements, which include the type of malocclusion as well as the size, shape, and colour of the maxillary canines [5]. Kokich and Kinzer [6] state that there are two types of malocclusions that allow for canine substitution (repositioning the canine in the lateral incisor's site). These include a Class II malocclusion with no crowding in the mandibular arch, or a Class I malocclusion with significant crowding in the lower arch, necessitating extractions.

The applicability of space closure will primarily depend on the maxillary permanent canine's ability to be modified to replace a lateral incisor effectively. This becomes critically important in cases of unilateral agenesis of maxillary lateral incisors, where the interdisciplinary team faces the challenge of achieving symmetrical appearance in the aesthetic zone [7]. The canine is generally longer and wider (mesiodistally and labiolingually) than the adjacent lateral incisor [7]. According to Chu [8], the canine that substitutes the lateral incisor is approximately 1 mm too wide, meaning that 0.5 mm of mesial and distal reduction should be performed to achieve the desired width. It is also necessary to reshape the lingual surface of the canine to obtain correct overjet and overbite, and the canine cusp tip also requires ameloplasty to correct its morphology [5].

Moreover, the maxillary canine is usually darker in colour, which can be exacerbated if extensive reduction is needed to flatten a canine with a prominent labial convexity. The first premolar is generally shorter and narrower than the adjacent canine. If these differences are not addressed, both aesthetic and functional outcomes will be compromised. Therefore, in cases of space closure, the following points should be taken into account [9]: a palatal root torque should be applied to the maxillary canine, mesial rotation of the first permanent premolars is desirable in most cases, the mesial and distal surfaces of the maxillary canine should be reduced to create a flatter surface rather than a convex one [9], the cusp tip of

Received: September 04, 2025; **Revised:** October 17, 2025; **Accepted:** October 22, 2025

the maxillary canine should be rounded to achieve a straighter incisal edge, similar to the lateral incisors, composite resin can be added to create incisal angles, with a more rounded distal angle, modifying the shape of the palatal surface of the maxillary canine to provide a more favourable anterior guidance, addressing colour differences between the darker maxillary canines and adjacent teeth and maintaining gingival height integrity, especially in patients with a high smile line, either through periodontal plastic surgery or orthodontically by intruding and extruding the maxillary first premolars and canines, respectively.

Clinical Case No 1 [Figure 1, 2, 3 and 4]

The patient is a 12-year-old girl in good general health, who presented with the absence of tooth 12, while the contralateral tooth was present in the arch.

Following the clinical examination and cephalometric analysis, the patient displayed the following characteristics:

- Skeletal Class I with a hyperdivergent profile;
- Biproalveolar protrusion;
- Left molar Class II, right molar Class I, and Class II canine relationships on both sides;
- A 19mm discrepancy in tooth size-arch length (DDM);
- Agenesis of the upper left lateral incisor, with the contralateral tooth presenting an anomaly in shape.

The treatment approach selected was space closure with canine substitution, following the extraction of teeth 35, 45, and a supernumerary tooth.

Fig. 1. [Pretreatment extraoral photographs. A, C: frontal views, B: profile view]

Fig. 2. [Pretreatment intraoral Photographs

A, C: Profile View, B: Frontal View, D: Occlusal View of the maxillary arch and E: Occlusal View of mandibular Arche]

Fig. 3. [Lateral Cephalometric Radiograph]

Space Opening and Prosthetic Replacement (clinical case no2 and no 3)

In Class I skeletal cases without mandibular arch crowding or proclination, the orthodontic space-opening treatment with prosthetic replacement is preferred over space closure to maintain the posterior occlusion [10]. Prosthetic options typically include an implant-supported prosthesis or a tooth-supported prosthesis.

Osteointegrated implants function as ankylosed teeth and should not be placed in growing patients due to the risk of progressive infraocclusion of the implant restoration. Research suggests that osteointegrated implants should not be placed before the age of seventeen in females and twenty in males [11].

Several years may pass between the completion of orthodontic treatment in an adolescent patient and implant placement due to continued facial growth and compensatory dental eruption [12], or simply due to financial constraints. A removable retainer with a prosthetic tooth is an appropriate method for temporarily restoring the edentulous space while providing short-term stability (case study number two). However, in cases where implant placement is delayed for several years, a fixed retainer (e.g., a resin-bonded bridge) is the preferred method [7] (Clinical Case no2).

Clinical Case No 2 [Figure 5, 6, 7, 8, 9, and 10]

This case involves a 17-year-old female patient in good general health who presented with the absence of the upper lateral incisors (teeth no12 and no 22).

Following a clinical examination and cephalometric analysis, the patient exhibited:

- Class I skeletal relationship, normodivergent
- Class I dental relationship with dento-maxillary discrepancy
- Agenesis of the upper lateral incisors

The treatment approach was to maintain the space and use a removable retainer with a prosthetic tooth until an implant-supported prosthesis could be placed.

Among conservative treatment options, the bonded bridge is the most conservative choice, as it requires minimal preparation of adjacent teeth. However, when the wings are metal, aesthetic concerns may arise, as it can sometimes give a grayish tint to the abutment teeth; this can be a relative contraindication. Therefore, the use of a fiber-reinforced composite resin bridge prevents the grayish discoloration often associated with metal substrates., enhancing the aesthetics in the anterior region [5].

On the other hand, a conventional bridge is a treatment option mainly considered in cases where the abutment teeth have existing restorations, discolorations, or require modifications in shape or size [5] (Clinical Case no 3).

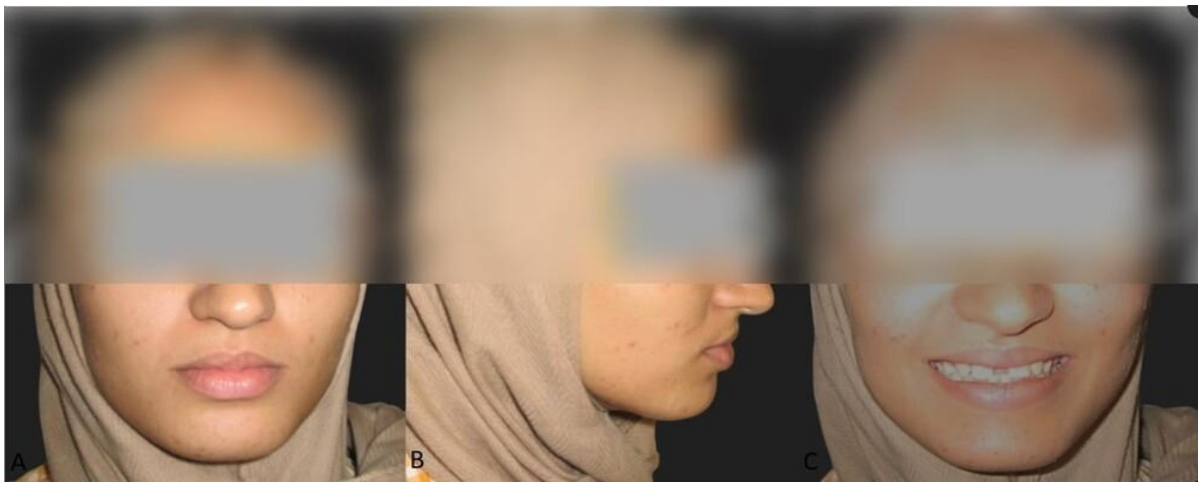

Fig. 5. [Pretreatment extraoral photographs A, C: frontal views, B: profile view]

Fig. 6. [Pretreatment intraoral Photographs A, C: Profile View, B: Frontal View]

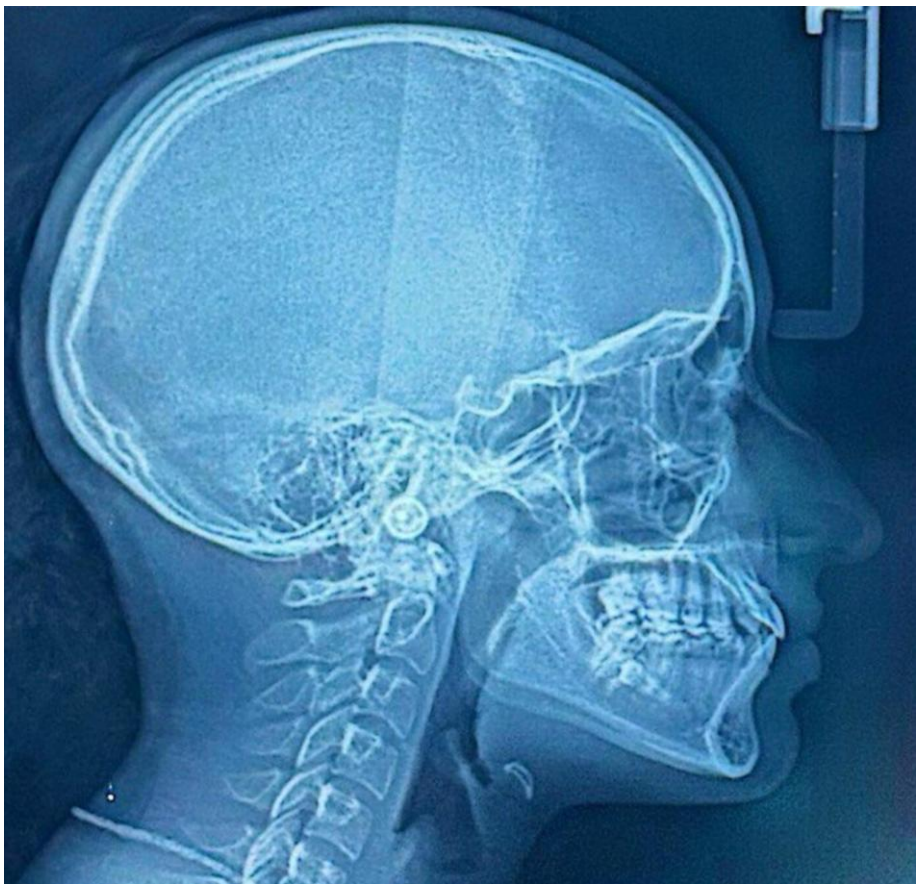

Fig. 7. [Lateral Cephalometric Radiograph]

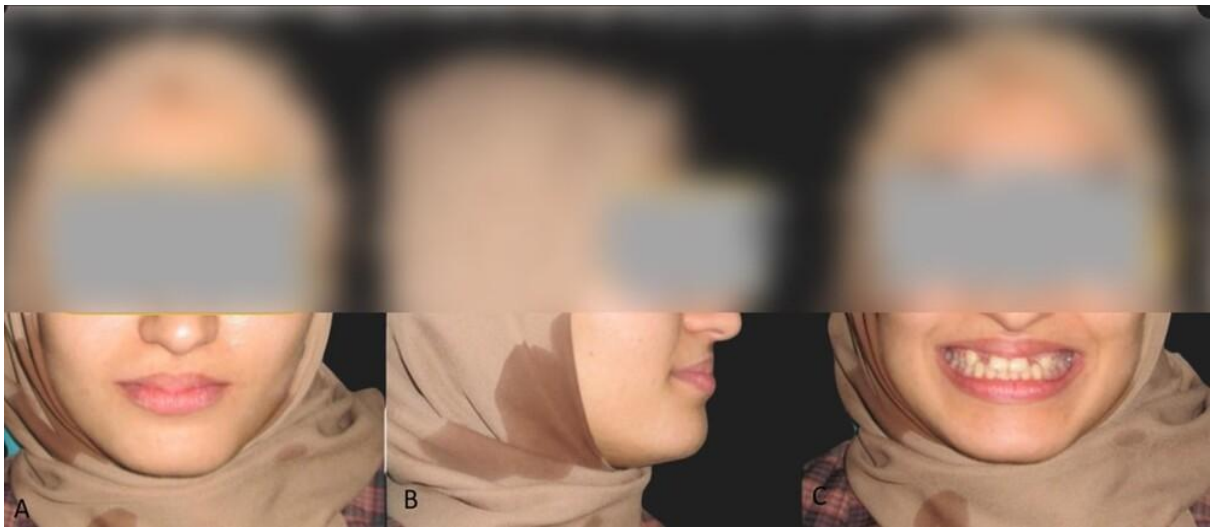

Fig. 8. [Post-treatment extraoral photographs A, C: frontal View, B: profile View]

Fig. 9. [Treatment Outcome Results]

Fig. 10. [A removable prosthesis replacing the congenitally missing lateral incisors 12 and 22.]

Clinical Case No 3 [Figure 11, 12, 13 and 14]

This case involves a 20-year-old female patient in good general health who presented with the absence of the upper lateral incisors (teeth no12 and no 22).

Following a clinical examination and cephalometric analysis, the patient exhibited:

- Class I skeletal relationship, normodivergent
- Class I dental relationship with dento-maxillary discrepancy
- Agenesis of the upper lateral incisors

The treatment approach was to maintain the space and proceed with prosthetic replacement using a conventional bridge.

Fig. 11. [Pretreatment extraoral photographs A, C: frontal View, B: profile View]

Fig. 12. [Pretreatment intraoral photographs

A, C: Profile View, B: Frontal View, D: Occlusal View of the maxillary arch and E: Occlusal View of mandibular Arche]

Fig. 13. [Post-treatment extraoral photographs A, C: frontal View, B: profile View]

Fig. 14. [Post-treatment intraoral photographs

A, C: Profile View, B: Frontal View, D: Occlusal View of the maxillary arch and E: Occlusal View of mandibular Arche]

Discussion

Orthodontic Space Closure vs Space Opening and Prosthetic Replacement

A successful and therefore satisfying dental treatment is always the goal for both patients and orthodontists. But what does a successful and satisfying treatment mean? It means that a patient's needs are addressed in a functional and, most importantly, aesthetic manner. This is particularly important in the anterior region, where patients tend to react more negatively if the aesthetic outcome is not perfect. However, the challenge for orthodontists is that each patient is an individual with different parameters related to facial, dental, smile, occlusal, and periodontal aesthetics. Patients and orthodontists often encounter different approaches to achieve the final goal, and together, they must find the best way to reach their shared objective of satisfaction [5].

Indeed, it is always important for professionals to explain the advantages and disadvantages of each treatment option, such as the total treatment time and the biological implications. Furthermore, therapeutic decisions should be linked to long-term outcomes, as changes over time are normal in biological systems.

Canine substitution can be an effective treatment solution if certain criteria are met. However, a team approach is often necessary to achieve an optimal aesthetic outcome. Indeed, the option of space closure and canine substitution can be employed to meet a patient's high aesthetic demands if used in the appropriate situation [5].

The implant approach in the anterior region is a delicate situation that can pose aesthetic challenges, especially in the long term. Biological and technical complications are common and can arise even after just a few years. Indeed, an osteointegrated implant behaves like an ankylosed tooth and cannot change position, unlike the neighboring natural teeth. Therefore, even slight movements of the adjacent teeth after the implant placement can lead to progressive infra-occlusion, which may occur over the years due to the continuous eruption of surrounding teeth. Additionally, disharmonious marginal gingival levels resulting from infra-occluded implant crowns can be a disadvantage for patients with a gummy smile [10]. Furthermore, the alignment of maxillary and mandibular incisors, which typically occurs from adolescence to adulthood and increases interincisal angles, could lead to protrusion of the implant crowns over time [10].

Indeed, the buccal cortical bone in the region of the lateral incisor is often thin, and progressive resorption can occur even if the implant had adequate alveolar bone support at the time of placement. Consequently, a bluish discoloration of the gingiva may appear, which has recently been reported in over 50% of patients with implant-supported crowns followed over a period of four years [13].

Moreover, the shorter the distance between the implant replacing the lateral incisor and the adjacent teeth, the more significant the reduction in marginal bone levels around the neighboring teeth. Thilander *et al.* [14] demonstrated a progressive reduction of interdental bone in adjacent teeth among certain patients in a 10-year follow-up study. The average amounts of bone loss around the adjacent maxillary central incisors were 3.2 mm after three years and 4.3 mm after ten years.

Long-term periodontal and occlusal studies [15,16] have shown that space closure and canine substitution can lead to an acceptable functional relationship, with a modified group function on the working side. These studies indicated that patients treated with space closure exhibited healthier periodontal health compared to those with prosthetic lateral incisors, and there was no difference in occlusal function between the two groups.

More recently, Robertsson and Mohlin [2] reassessed 50 patients with agenesis of the lateral incisors. They found that patients treated with space closure and canine substitution were more satisfied with their treatment outcomes than those treated with space opening and prosthetic replacement, with no difference between the two groups in the prevalence of signs and symptoms of temporomandibular joint dysfunction. Additionally, patients with prosthetic replacements exhibited a deterioration in periodontal health. It was concluded that space closure and canine substitution produce results that are well accepted by patients without impairing temporomandibular joint function and periodontal health compared to those who underwent space opening and prosthetic replacement [15-17].

When establishing a treatment plan for patients with agenesis of the maxillary incisors, it is essential to meet their aesthetic requirements [18]. Nordquist and McNeill [16] in 1975 and Robertsson and Mohlin [2] in 2000 found that patients who underwent space closure with canine substitution were more satisfied with their aesthetic results than those treated with space opening and a bridge. Neither of these studies included patients with implant-supported crowns.

In 2014, De-Marchi *et al.* [18] evaluated photographs of the lower third of the face of patients who had undergone either space opening with implant replacement or space closure with canine substitution. They found no significant difference in the perception of smile aesthetics between dentists and the public. However, the study noted that the photographs might distract respondents, particularly non-dentists, due to factors like lip fullness or skin texture and colour.

Similarly, a retrospective study by Jamilian *et al.* [19] in 2015, which compared five patients treated with orthodontic space closure to 5 patients treated with implant-supported crowns, also revealed no difference in patient satisfaction regarding aesthetic outcomes. Together, these studies suggest that aesthetic perceptions may not significantly differ between these treatment modalities, although external factors can influence evaluations.

In summary, the choice between orthodontic space closure with canine substitution and space opening with prosthetic replacement in cases of maxillary lateral incisor agenesis depends on several factors, including patients' aesthetic requirements, functional outcomes, and short- and long-term periodontal health outcomes. Both approaches can provide satisfactory results; however, existing literature suggests that the option of space closure and canine substitution are often preferred by patients due to their aesthetic and functional outcomes.

In conclusion, as previously discussed, the anterior region presents a delicate situation that can pose aesthetic challenges, particularly in the long term. Many cases require a collaborative effort from multiple specialties to achieve the optimal aesthetic outcome for each individual.

It is crucial that every team member is fully aware of their role; otherwise, the results can be compromised or even disastrous. These complications can be avoided by systematically designing a multidisciplinary treatment plan.

Declarations

Ethical Clearance

Written informed consent for the publication of clinical details and/or clinical images was obtained from the patients, or their legal guardians in the case of minors. The consent includes permission for

the publication of clinical information and photographs. Any identifying features, such as medical record numbers or codes, have been removed from the clinical images to ensure patient anonymity and confidentiality.

Conflict of interest

No competing interests were disclosed.

Funding/ financial support

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

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Acknowledgements

The author(s) declare that no acknowledgments are applicable for this work.

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