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Interdisciplinary Orthodontic-Aesthetic Makeover Treatment of Nonsyndromic Hypodontia Case

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Received: 28 July 2024 | **Revised:** 4 March 2025 | **Accepted:** 23 March 2025

Funding: The authors received no specific funding for this work.

Keywords: canine substitution | hypodontia | missing laterals | restorative approach | retained deciduous teeth | space closure mechanics

ABSTRACT

This case study demonstrates treating maxillary lateral incisor agenesis in a male with class II div. 2 malocclusion using space closure and canine re-anatomization. It emphasizes the importance of a multidisciplinary team approach for minimally invasive, aesthetically pleasing results in orthodontic and restorative dentistry.

1 | Introduction

Hypodontia is the most common dental abnormality that can manifest as a lack of one or more teeth [1]. The presence of missing front teeth with class II div 2 incisor relationships in young patients is a significant challenge for dentists [2, 3]. It can manifest as a syndrome component, such as cleft lip and palate or ectodermal dysplasia, or as a non-syndromic disorder [4]. Although the exact cause of hypodontia remains unknown, researchers believe that the environment or genes play a role [5].

Hypodontia is frequently associated with microdontia, taurodontism, abnormal tooth eruptions, delayed tooth growth, ankylosis, and infra-occlusion [6]. Studies have shown that between 1.6% and 6.9% of individuals experience hypodontia, depending on the population being studied. Most affected individuals are missing one or more teeth, the most common missing teeth being upper lateral incisors and permanent second premolars [7, 8].

Patients with class II div. 2 incisor relationships and maxillary lateral incisor agenesis (MLIA), a form of tooth agenesis with an incidence of 2.2%, face significant functional, psychological, and aesthetic consequences. Clinicians face challenges in both orthodontic and restorative interventions when one or both maxillary lateral incisors are absent congenitally. Class II div. 2 malocclusions have the central incisors palatally inclined instead of proclined. The idea that genetics is a major factor in the development of class II div. 2 malocclusion has been put forth numerous times [9].

According to a recent study by Peck et al. [10], class II div. 2 malocclusions with a deep bite may be additive and polygenic in origin due to the combined manifestation of anatomical

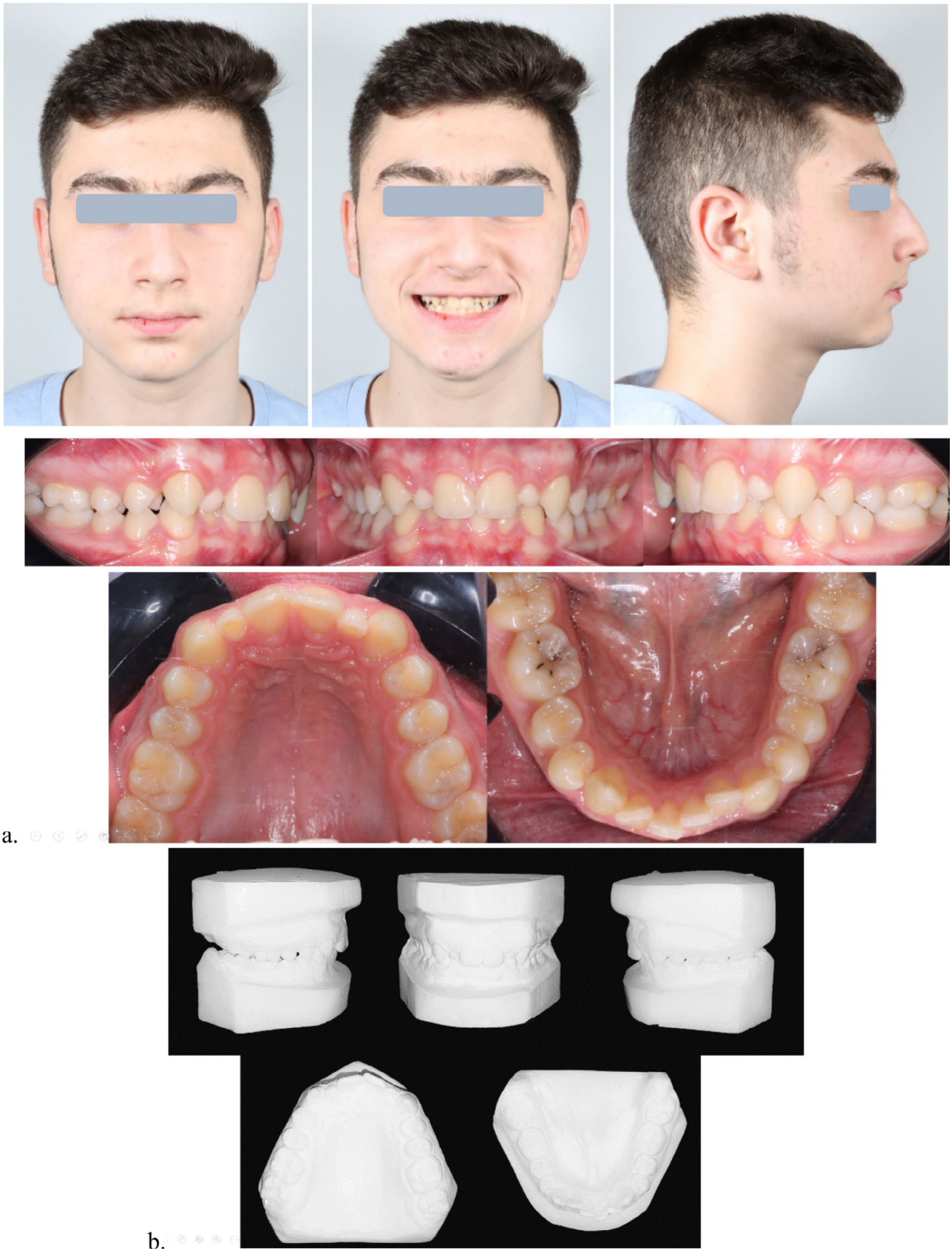


FIGURE 1 | Shows (a) pre-treatment extra and intra-oral photography; (b) Dental Models; (c) pre-treatment orthopantomogram (O.P.G) and cephalometric radiographs.

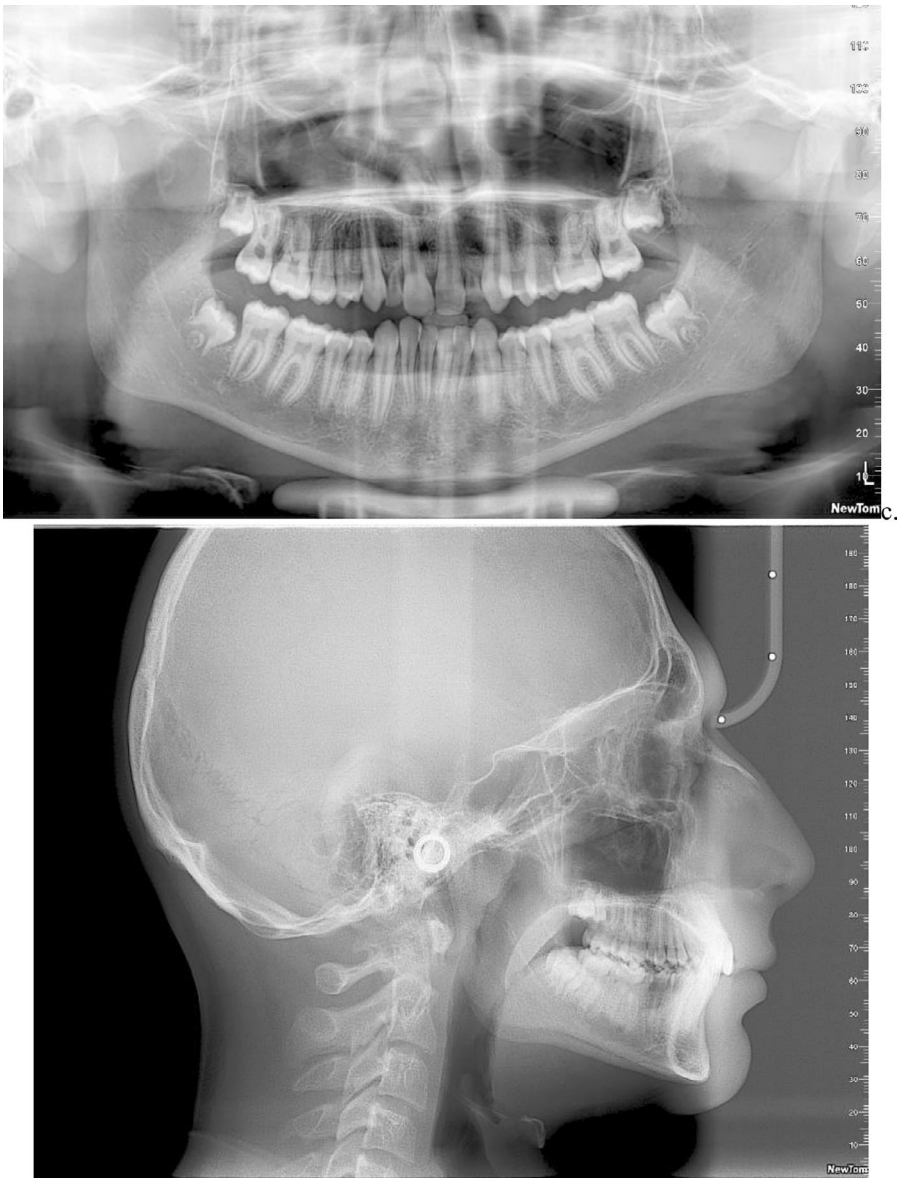


FIGURE 1 | (Continued)

components that are genetically determined [11]. There is a growing understanding of the genetic underpinnings of tooth formation. Missing teeth, peg-shaped laterals, transpositions, supernumeraries, and impactions are examples of abnormalities that are most likely linked to genetic disorders related to tooth formation [12, 13].

The most prevalent congenitally absent permanent tooth condition in the maxillary anterior region (aesthetic zone) is MLIA, accounting for about (20%) of all dental anomalies. The prevalence of missing maxillary lateral incisors varies among populations, with reports ranging from (0.8% to 4.25%) [14, 15]. Bilateral MLIA cases are more commonly recorded than unilateral cases, and it is more common in women [16].

The management of patients with bilateral MLIA necessitates a comprehensive strategy that is interdisciplinary, particularly due to its location in a visually conspicuous area [17]. Depending on the extent of hypodontia, a choice can be made to either retain, enlarge, or reduce the gap caused by the absence of the lateral incisors [18]. The decision relies on factors such as specific malocclusion, skeletal relationship, arch length, tooth size difference, smile line, canine morphology, and ridge thickness. Aside from the clinical features of the patient, it is crucial to ascertain the patient's expectations and willingness to collaborate during the potentially lengthy treatment process [19, 20]. Empirical data suggest that individuals with canine substitution experience enhanced periodontal well-being and express more contentment with their physical appearance in comparison to those utilizing dental prostheses [21].

This case report describes the treatment of a 15-year-old male with a class II div. 2 malocclusion and bilateral MLIA. A multidisciplinary approach was employed, involving orthodontics with fixed appliances to close the spaces and replace the missing lateral incisors with the canines and the canines with the first premolars. However, it is difficult to achieve exceptional

TABLE 1 | Cephalometric analysis (T1 Pre-treatment; T2 Post-treatment).

Variable	Norms	T1	T2
SNA	81° ± 3°	81.1°	81°
SNB	78° ± 3°	78.2°	78.8°
ANB	3° ± 2°	2.9°	2.2°
MMPA	27° ± 5°	31°	30°
Face height ratio	55% ± 2%	54%	54%
SN to maxillary plane	8° ± 3°	8°	8°
Upper incisor to maxillary plane	109° ± 6°	99°	114°
Lower incisor to mandibular plane	93° ± 6°	93°	96°
Interincisal angle	135° ± 10°	139°	137°
Wits appraisal	0–1 mm	2 mm	1 mm
Lower incisor to A-Po line	1 ± 2 mm	2 mm	3 mm
Upper lip to E-Line	−3 ± 2 mm	−5 mm	−3 mm
Lower lip to E-Line	−1 mm ± 2 mm	−2 mm	−1
Nasolabial angle	100° ± 10°	125°	105°

Abbreviations: ANB, point A-Nasion-point B; MMPA, maxillomandibular plane angle; SNA, Sella-Nasion-point A; SNB, Sella-Nasion-point B.

aesthetic and functional outcomes that closely resemble natural teeth, particularly when replacing missing lateral incisors with canines. The successful completion of this treatment necessitates cooperation between the orthodontist and the restorative dentist at every stage. This case study outlines the difficulties encountered in the treatment process and offers strategies to attain optimal aesthetic outcomes.

2 | Case Presentation/Examination

A 15-year-old male came to the clinic with a chief complaint: "I don't like my smile." He had no significant medical or family history and had no allergies. He presented as a mesocephalic and oval face shape, a class II div. 2 malocclusion with overjet of 1 mm and deep overbite (4 mm) based on a class 1 skeletal relationship with a slight mandibular deviation to the right. There was some asymmetry w.r.t condyles and mandibular rami. Also, he presented with average vertical proportions, with carious lower 1st molars. The upper midline did not coincide with the facial midline and was shifted about 1 mm to the right side; the smile arc was non-consonant, with a wide buccal corridor. The upper arch presented with a round arch form and mild crowding (2 mm), congenitally missing lateral incisors, and retained deciduous laterals. The lower arch showed a round arch form and mild crowding (4 mm). The molar relationship was a class II half-unit on the right side and a quarter unit on the left side, and the canine relationship was a class II half-unit on the right side and a quarter unit on the left side. The profile was convex with an obtuse nasolabial angle and competent lips (Figure 1; Table 1).

3 | Methods (Differential Diagnosis, Investigations, and Treatment)

Based on the diagnosis, the goals of treating this patient's case included:

1. Space closure and improving the smile arc and gingival level.
2. Artistically shaping and replacing the canines.
3. Correcting the midlines of the upper and lower arches.
4. Maintaining the patient's overjet and overbite.

3.1 | Treatment Planning

The patient was initially photographed, and then maxillary and mandibular scans were performed using an intraoral scanner (Trios-3shape, USA). A DSD (Digital Smile Design) and digital setup was utilized to facilitate the patient's visualization of the anticipated outcome. Upon receiving consent from both the patient and his father, a treatment plan was devised to address the issue of spacing between the lateral incisors. It was decided to substitute the canines in place of the lateral incisors and first premolars in place of the canines after extraction of retained deciduous lateral incisors, while also moving the posterior teeth forward. This decision was influenced by the patient's low smile line, reduced gingival show, and the fact that the canines had already partially moved into the spaces meant for the lateral incisors. Furthermore, the gingival margin of the canines was positioned low, and the canines themselves were relatively small in size and were brighter and similar in color to the lateral incisors.

3.2 | Treatment Alternative

The authors were considering another treatment plan, which was to open space for maxillary congenitally missing lateral incisors and replace them with prostheses such as a Maryland bridge, and then replace them with implants at a later age due once residual growth of the alveolar processes is completed. This option was not accepted due to financial constraints and aesthetic compromises associated with anterior prosthesis.

3.3 | Orthodontic Treatment Progress

Upper and lower 0.022″ MBT prescription (Dentaurum, Germany) brackets were used as fixed orthodontic appliances. To decrease canine prominence and permit a greater palatal root torque, lateral incisor brackets were affixed to the upper canines following minimal enameloplasty on the labial surface. To improve aesthetics, the upper first premolar brackets were fixed in a slightly distal position, rotating the premolars mesially. The

FIGURE 2 | Show (a) leveling and alignment, closing lateral incisors spaces used Push-pull mechanics on 0.020" Stainless-Steel arch wire assisted by two palatal mini-implant with NiTi closing retraction coil; (b) aesthetic makeover approach (minimally invasive technique includes canine re-anatomization using composite restoration material).

arches were leveled and aligned with 0.012, 0.014, and 0.018-inch NiTi archwires.

Space closure was achieved using two palatal TADs (2×12 mm, OrthoTechnology-USA) with NiTi closed coil springs (OrthoTechnology-USA), and a custom-made transpalatal arch bonded to upper 1st molars. Push-pull mechanics on the upper anterior segment with open-coil springs between the 1st premolars and canines and a power chain between canines and central incisors were utilized on a 0.020″ inch stainless-steel round archwire. We treated the lower arch with leveling, alignment, and inter-proximal reduction at the lower incisors to correct the shift in the lower midline. We also achieved labial root torque in the upper first premolars to lessen the appearance of the palatal cusp and enhance the root eminence. We also achieved palatal root torque in the canines by placing lateral incisor brackets on the canines and canine brackets on the 1st premolars.

Before debonding, we had an interdisciplinary discussion with the restorative consultant to identify the final position that would be both aesthetically acceptable and functional without jeopardizing the stability of the occlusion. All goals were met

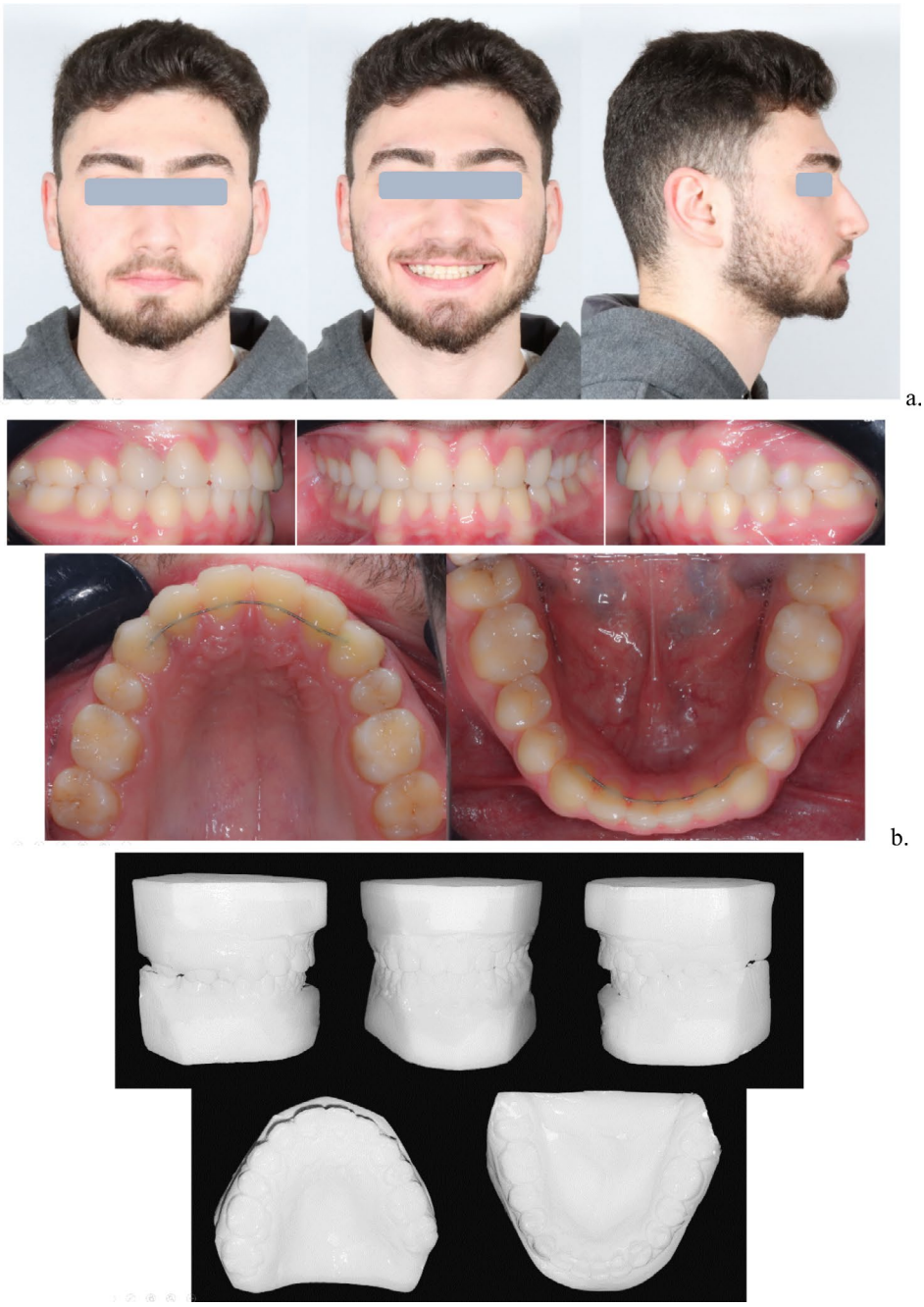
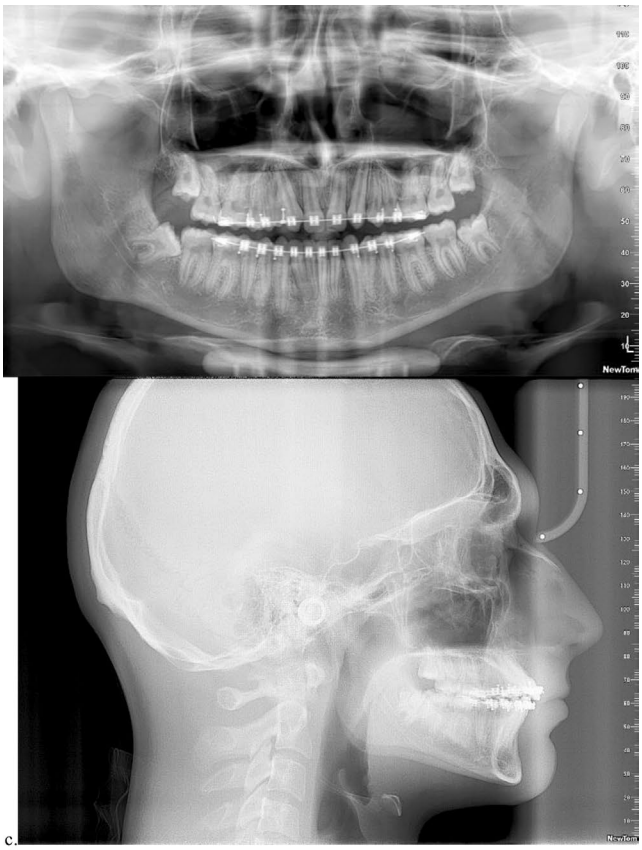


FIGURE 3 | Show (a) post-treatment extra and intra-oral photography; (b) dental models; (c) Post-treatment radiograph (O.P.G) and cephalogram (d) cephalometric superimposition; general superimposition with maxillary superimposition and mandibular superimposition.

after 24 months of active orthodontic treatment; the appliance was debonded, and the patient was directed to have aesthetic restorative care (Figure 2). Maxillary and mandibular third molars were extracted subsequently.

3.4 | Restorative Progress

The decision was made to use a minimally invasive technique to reshape the canines and first premolars. They were restored using a direct composite resin material (Tetric-N-Ceram, Ivoclar Vivadent) in incremental layers with reduced lingual cusps on 1st premolars. White stone finishing burs (Dura-White, Shofu-japan) were used for finishing and occlusal correction, while the composite polishing kit (OptiDisc, Kerr, USA) was used for polishing. Interproximal finishing strips (OptiStrip, Kerr, Bioggio, Switzerland) were employed to remove excess material and achieve precise line angles. Following occlusal correction, silicone polishing tips (Enhance, Dentsply, USA) were utilized on the lingual surface. The patient received oral hygiene advice. The final aesthetic assessment of the hue and surface quality of the dental repair was conducted 15 days after the restorative procedure (Figure 2).



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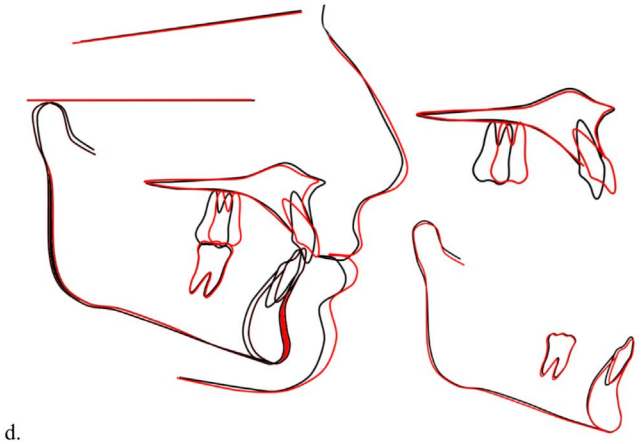

d.

FIGURE 3 | (Continued)

4 | Conclusion and Results (Outcome and Follow-Up)

The treatment was completed in 24 months with a class I canine relationship on both sides, a bilateral full unit class II molar relationship with normal overjet, overbite, and a good interincisal angle. Upon comparing the photographs taken before and after the treatment, it was clear that the patient's lateral profile had seen a noticeable improvement (Figure 3). The maxillary incisor position was well maintained with just a controlled tipping of the root apex, which supported the upper lip well, as shown in Figure 3. This was clearer in the post-treatment cephalometric radiograph showing the correction of incisor inclination, torquing, interincisal angle, and bone remodeling at the anterior profile of the maxilla. After undergoing 2 years of treatment, the fixed appliance was removed, and a permanent retainer along with a vacuum-formed retainer was provided for the upper arch, and only a permanent retainer was used for the lower arch (Figure 4). We provided the patient with clear and precise instructions for the nightly usage of the retainers to avoid any alterations in occlusion and the finished result. Both the patient and his parents expressed satisfaction with the treatment results. After a 3-year follow-up, it is evident that the outcome remained stable (Figure 5).

The successful interdisciplinary management of a patient with congenitally missing lateral incisors demonstrated the effectiveness of a collaborative approach involving an orthodontist, restorative dentist, implantologist, and prosthodontist. The long-term follow-up indicated that gap closure using orthodontic and restorative procedures proved more advantageous for the patient than opting for a prosthetic solution.

5 | Discussion

A significant segment of the population has MLIA. Due to its potential to greatly affect the appearance of teeth and the face, there is a high demand for orthodontic treatment among those affected [9]. In this case report, the patient underwent a successful treatment that involved a multidisciplinary approach. The treatment included closing the spaces using orthodontics and reshaping the canines to resemble the maxillary lateral incisors using restorative dentistry. The entire treatment took 24 months to complete.

The management of these patients is a formidable task for orthodontists and restorative dentists because of the evident influence that this condition exerts on facial and dental aesthetics. Nevertheless, research has demonstrated that closing the space, when feasible, is consistently the optimal choice for individuals with congenitally absent teeth due to various factors, including improved periodontal health, minimal long-term burden, and the potential for achieving satisfactory aesthetic and functional outcomes through proper re-anatomization [22, 23].

Research has demonstrated that patients generally express more satisfaction with the results of space closure treatment as opposed to individuals who had space opening and prosthetic rehabilitation [24]. Robertson and Mohlin [25] studied the benefits of space closure with orthodontic treatment and revealed the following findings: (1) The space-closure patients were individuals who had gaps in their teeth that needed to be filled by prosthetic rehabilitation; (2) there were no significant differences in the occurrence of signs and symptoms of temporomandibular joint dysfunction between the two groups; (3) patients with prosthetic replacements exhibited compromised periodontal health, characterized by the buildup of plaque and the presence of gingivitis. When dealing with space closure, it is important to consider the following factors: (1) precise adjustment of the crown torque of canines that have been moved mesially to match the optimal torque of the lateral incisors while also ensuring optimal torque and rotation for the premolars that have been moved mesially; (2) bleaching of the canines, as these teeth tend to be more

FIGURE 4 | Retention protocol (include used permanent retainer with a vacuum-formed retainer was formed for the upper arch and only a permanent retainer was formed for the lower arch).

yellowish compared to the incisors; (3) the duration of space closure, rotation during subsequent mesial movement, presence of two roots, and differential bracket bonding, where the canines are placed with lateral incisor brackets [26, 27]. Typically, adjustments are required to correct the gingival level in cases with canine extrusion and premolar intrusion.

We accomplished the initial treatment goals and addressed the patient's main concerns. The patient's facial features remained largely unaltered, except for the location of the upper and lower lips in relation to Rickets' E-line (Table 1). This position has improved, most likely due to natural forward growth rather than the treatment itself.

Some studies have indicated that choosing to close the space of a congenitally missing lateral incisor can lead to changes in the way the teeth come together, such as disocclusion of certain groups of premolars [28, 29]. These changes can impact the health of the gums, teeth, and the function of the temporomandibular joint. A clinical study found that patients who had space closure and recontouring of the canines did not have any changes in their ability to bite or speak, the number of times their cervical discs were broken, or any signs of temporomandibular dysfunction (TMD) symptoms. The study also found no correlation between TMD and either canine or group function [30].

The malocclusion was effectively corrected, resulting in a normal overbite, overjet, and good interdigitation that is expected to greatly enhance the likelihood of maintaining the corrected position in the long term. Given that the patient completed the treatment course at the age of 18, it is likely that his facial growth was already complete, and the treatment results would stay stable if the retainers were worn properly.

a.

b.

FIGURE 5 | Three-year follow up; (a) follow-up extra-oral and intra-oral photography; (b) follow-up orthopantomograph (O.P.G).

Author Contributions

Hasan Sabah Hasan Al-Nuaimi: conceptualization, formal analysis, investigation, methodology, writing – original draft. **Zamri Bin Radzi:** validation, visualization, writing – original draft. **Adith Venugopal:** methodology, validation, writing – review and editing.

Consent

Written informed consent has been provided by the patient for the purpose of publication of this report.

Conflicts of Interest

The authors declare no conflicts of interest.

Data Availability Statement

The authors have nothing to report.

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