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Review article

Comprehensive insights and clinical pathways for managing congenitally missing mandibular incisors: A literature review

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Abstract Congenitally missing mandibular incisors present a unique clinical challenge in orthodontics due to their relative rarity and association with craniofacial variations. This literature review synthesized existing case reports and studies to outline diagnostic considerations, craniofacial characteristics, etiology, and treatment strategies. Genetic factors, developmental anomalies of the mandibular symphysis, and evolutionary theories have been implicated in the etiology of incisor agenesis, with higher prevalence observed in East Asian populations. Affected individuals often exhibit skeletal Class III tendencies and distinctive mandibular symphysis morphology. Treatment modalities include extraction strategies, space closure, and prosthetic space creation, with planning guided by Bolton analysis, digital model setup, and facial esthetics. A treatment decision flowchart was developed based on decades of clinical evidence to support individualized, interdisciplinary care. Advances in 3D imaging and digital simulation offer enhanced precision in evaluating treatment feasibility and outcomes. This review emphasizes the importance of integrating skeletal analysis, occlusal balance, and patient-specific factors to achieve optimal functional and esthetic results in cases of congenitally missing mandibular incisors.

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Introduction

In cases of congenitally missing teeth, the most frequently affected tooth is the mandibular second premolar, followed by the maxillary lateral incisor, maxillary second premolar, and mandibular incisors.[1] Although agenesis of the mandibular incisors is relatively rare, "three-incisor" and "two-incisor" patterns present unique challenges for orthodontic treatment (see Table 1, Fig. 1).

The field of orthodontics offers several treatment strategies for specific alignment and missing-tooth issues. Howard J. Buchner successfully corrected cases of three lower incisors by extracting the corresponding upper lateral incisor.[2] Removing two upper first premolars is another common strategy, particularly for patients with Class II division 1 malocclusion,[3] bimaxillary protrusion,[4] or crowded maxillary teeth.[4,5] For individuals missing two lower incisors, Newman[6] reported a method of "canine substitution," where canines replace lateral incisors and premolars replace canines. Alternatively, Nagaveni and Umashankara[7] have advocated for removable partial dentures, while Prakash and Hallur[8] used temporary composite fillings. Kagitha and Namineni[9] also presented a solution using a lingual arch-supported acrylic prosthesis.

Despite the diversity of treatment options, accurate Bolton analysis and digital model set-up are crucial for achieving optimal arch coordination.[10,11] Huang and Yang[10] pointed out that extracting a mandibular premolar from the side without a missing tooth has less effect on the Bolton index than extracting a central incisor.[10]

Craniofacial pattern

Although the topic of congenitally missing teeth has attracted considerable attention, orthodontists have observed that such patients often exhibit distinct craniofacial morphologies.[12–14] Sarnäs and Rune's study[15] revealed that children with hypodontia exhibit a more retrognathic maxilla and a diminished sagittal jaw relationship angle. Similarly, Costa and Trevizan's study[16] found that tooth agenesis is linked to a smaller ANB angle. Both Chung and Hobson[17] and Acharya and Jones[18] suggested a tendency toward a Class III skeletal relationship in patients with hypodontia. In contrast, Kreczi and Proff[19] concluded that tooth agenesis may negatively affect sagittal jaw development, whereas Yüksel and Uçem,[20] as well as Tavajohi-Kermani and Kapur,[21] reported minimal impact on overall dentofacial structure and cephalometric measurements.

Beyond traditional cephalometric indicators, Endo and Ozoe[22] focused on the morphology of the mandibular symphysis. Their findings revealed retroclination of the mandibular incisors and alveolar bone, along with a reduced mandibular alveolar bone area. Chen et al.[23] further reported no significant differences in the anteroposterior positioning of the maxilla and mandible, but noted compromised facial balance in patients with congenitally missing incisors, characterized by a more prominent chin button. These craniofacial associations underscore the importance of comprehensive craniofacial assessment in treatment planning for patients with congenitally missing mandibular incisors. Further research with the use of three-dimensional image should be done to give us better understanding of the relationship between the morphology of mandible and congenitally missing mandibular incisors.

Etiology and prevalence

According to the literature, several theories have been proposed to explain the etiology of congenitally missing mandibular incisors. Heredity or familial patterns are among the most commonly cited causes. Developmental anomalies of the mandibular symphysis may disrupt the dental tissues responsible for forming the tooth buds of the lower incisors. Some researchers have suggested that the congenital absence of mandibular incisors may represent an evolutionary trend—a natural reduction in dentition as an adaptation to shortened dental arches.[24] In addition, inflammation or infection in the jaw has been considered a potential risk factor that may damage developing tooth buds.

From a histological perspective, the congenital absence of teeth results from disturbances during the early stages of tooth development—specifically, the initiation and proliferation phases.[25] Genetic mutations in *MSX1*, *PAX9*, *AXIN2*, *TGFA*, and *EDA* have been identified as contributing factors in human tooth agenesis.[7,8,26] The prevalence of congenitally missing permanent teeth has been reported extensively in the literature.[15,21] Among these, the mandibular second premolars are the most commonly affected teeth. The second most frequently missing teeth are either the maxillary second premolars or the maxillary lateral incisors, depending on the population studied. While the congenital absence of mandibular central and lateral incisors is comparatively less common, it is not considered rare. In terms of permanent lateral incisor agenesis, the maxilla is more commonly affected than the mandible.[27] The reported prevalence of missing mandibular central and lateral incisors is approximately 3.5 % and 3.0 %, respectively.[18]

In terms of ethnic variation, the prevalence of congenitally missing teeth has been reported to be higher in European and Australian populations compared to those in North America. A higher occurrence of congenitally missing mandibular incisors has also been observed in East Asian populations, particularly among Japanese, Korean, and Chinese individuals.[24,28] One study found that the lower central incisors are more commonly missing in the Swedish population compared to other ethnic groups.[29] Regarding gender differences, the prevalence of congenitally missing teeth is approximately 1.37 times higher in females than in males.[1]

Treatment modalities

Orthodontists have been discussing the challenges associated with congenitally missing mandibular incisors for several decades, and numerous case reports have been published, most of which demonstrate acceptable clinical outcomes. Huang et al.[10] emphasized the importance of

Table 1 Brief summary of treatment procedures of case reports.

Title	Cases	Treatment Procedures	
Treatment of cases with three lower Incisors[2]	2	case1	one congenitally missing mandibular incisor ➔ extract ipsilateral maxillary lateral incisor
		case 2	lower anterior crowding ➔ extract one mandibular incisor which is lingually block-out and ipsilateral maxillary lateral incisor
Two Class II, Division 1 patients with congenitally missing lower central incisors[3]	2	Both cases have two congenitally missing mandibular incisors.	
		case 1	Phase I: Kloehn-type cervical headgear Phase II: extract two maxillary first bicuspids and wear J-hook high-pull headgear
		case 2	Phase I: Kloehn-type headgear Phase II: extract two maxillary first bicuspids
Treatment of a patient with a crowded Class I malocclusion and a congenitally missing mandibular incisor[4]	1	Class I bimaxillary protrusion, upper canines block-out, one congenitally missing mandibular incisor ➔ extract two maxillary bicuspids and another mandibular lateral incisor with interproximal reduction	
Treatment of a Class III malocclusion with a missing mandibular incisor and severe crowding[5]	1	Profile: straight to convex; dentition: crowding, one congenitally missing mandibular lateral incisor ➔ extract two maxillary bicuspids and the remaining mandibular lateral incisor with interproximal reduction	
Congenitally missing mandibular incisors: treatment procedures[6]	2	case 1	two congenitally missing mandibular incisors ➔ non-extraction of maxillary dentition; mandibular dentition: first premolar substitutes for canine, and canine substitutes for lateral incisor
		case 2	two congenitally missing mandibular incisors ➔ non-extraction of maxillary dentition; mandibular dentition: first premolar substitutes for canine, and canine substitutes for lateral incisor
Congenital bilateral agenesis of permanent mandibular incisors: case reports and literature review[7]	4	Four patients all have two congenitally missing mandibular central incisors, and all of them rejected further treatment	
		case 1	Retained milk tooth ➔ suggest removable partial denture, but patient rejected
		case 2	Retained milk tooth ➔ suggest removable partial denture, but patient rejected
		case 3	Spacing ➔ suggest removable partial denture, but patient rejected
		case 4	Spacing ➔ suggest space closure with orthodontic treatment, but patient rejected
Interim restorative approach for the management of congenitally missing permanent mandibular incisors: presentation of three cases[8]	3	case 1	Two congenitally missing mandibular incisors with two retained milk teeth ➔ composite interim restoration was done
		case 2	Two congenitally missing mandibular incisors with two retained milk teeth ➔ composite interim restoration was done
		case 3	Four congenitally missing mandibular incisors

(*continued on next page*)

Table 1 (*continued*)

Title	Cases	Treatment Procedures	
			➜ composite interim restoration was done
Agenesis of permanent mandibular central incisors: a concordant condition in sibling[9]	2	The two sisters had no family history of congenitally missing teeth; however, they both had two congenitally missing mandibular incisors. ➜ Lingual arch-supported acrylic prosthesis was done	
Clinical experience of orthodontic treatment on 36 cases with congenital lower incisor missing[10]	36	Refer to Bolton ration for diagnosis; moderate amount of interproximal reduction might be needed	
		19 cases	One missing mandibular central incisor
		13 cases	Two missing mandibular central incisors
		2 cases	One missing mandibular lateral incisor
		2 cases	Two missing mandibular lateral incisors
		1 case	Four missing mandibular incisors
Lower incisor extraction in orthodontic treatment[11]	3	case 1	Posterior buccal interdigitation is good; lower anterior crowding ➜ extract one mandibular lateral incisor; non-extraction of maxillary dentition
		case 2	Posterior buccal interdigitation is good; lower anterior crowding ➜ extract one mandibular central incisor; non-extraction of maxillary dentition
		case 3	Class I malocclusion with normal maxillary dentition and good buccal interdigitation; lower anterior arch length deficiency is greater than 4-5 mm; anterior tooth ration is more than 83 mm; optimal treatment plan is four bicuspids extraction, but patient hesitates ➜ extract one mandibular central incisor; non-extraction of maxillary dentition
An indication for the three incisor cases[30]	2	case 1	one congenitally missing mandibular incisor ➜ non-extraction, interproximal reduction of maxillary dentition
		case 2	lower anterior crowding ➜ extract one mandibular lateral incisor; non-extraction of maxillary dentition
Lower incisor extraction in orthodontic treatment: Four clinical cases[31]	4	Diagnostic wax-up could help diagnosis	
		case 1	The author was worried about worsening the facial profile if four bicuspids extraction ➜ extract one mandibular incisor; maxillary dentition: interproximal reduction
		case 2	Class II malocclusion ➜ Maxillary dentition: extract two first bicuspids; mandibular dentition: extract one incisor with interproximal reduction
		case 3	Class II, division 2 malocclusion ➜ Maxillary dentition: non-extraction; mandibular dentition:

Table 1 (*continued*)

Title	Cases	Treatment Procedures	
			extract one incisor
		case 4	Class II, division 2 malocclusion ➔ Maxillary dentition: extract two bicuspids; mandibular dentition: extract one incisor with interproximal reduction
Bilateral agenesis of permanent mandibular central incisors: reports of two cases[32]	2	These two cases were presented with two congenitally missing mandibular central incisors. No treatment was done.	
Report of four familial cases with congenitally missing mandibular incisors[34]	4	The following four cases all have the familial history of congenitally missing mandibular incisors. The author didn't choose to create space for prosthesis considering the longer treatment duration. They didn't extract two maxillary bicuspids due to the fact that the profile of these patients are flat.	
		case 1	One congenitally missing mandibular incisor ➔ space closure, occlusal adjustment
		case 2	One congenitally missing mandibular incisor ➔ space closure, occlusal adjustment
		case 3	Two congenitally missing mandibular incisors ➔ space closure, occlusal adjustment
		case 4	Two congenitally missing mandibular incisors ➔ space closure, occlusal adjustment

considering both the Bolton ratio and the facial profile during treatment planning.

Common treatment approaches for patients with congenitally missing mandibular incisors include: (1) extraction of the maxillary first premolars to achieve arch coordination; (2) space creation in the lower anterior region for prosthetic replacement; and (3) space closure in the missing tooth area. In addition, some clinicians have proposed extracting a single mandibular incisor as a treatment option in cases of pseudo-Class III malocclusion or in patients with severe lower anterior crowding.

Based on the literature reviewed, a treatment modality flowchart (Figure) for managing congenitally missing mandibular incisors could be established. Initial consideration for cases presenting with maxillary dentition protrusion and crowding involves the extraction of premolars. Subsequently, in cases where a three-incisor configuration is present, an additional incisor may be extracted to address a significant space deficiency, whether due to crowding or procumbency. While this approach offers advantages such as maintaining tooth number symmetry and improving dental arch coordination, a thorough Bolton ratio analysis is still required. Alternatively, if extraction is not indicated, interproximal reduction can be utilized to achieve maxillary and mandibular arch coordination. Finally, for two-incisor cases, the decision to create space for a prosthetic restoration or to close all residual spaces is determined by the patient's facial esthetics and overjet.

In cases without maxillary dentition protrusion and crowding, an ipsilateral maxillary extraction may be selected. However, for most cases, a non-extraction approach is often preferred due to the esthetic considerations of the "social six". Again, Bolton ratio calculations and a model set-up are necessary to ensure coordinated occlusion. The decision to perform a mandibular extraction is based on the patient's craniofacial pattern. For instance, in a skeletal Class III three-incisor case, the extraction of one contralateral incisor is often chosen to achieve a more pleasing aesthetic and occlusal outcome. In addition to the flowchart, the treatment modalities are categorized into the following sections to provide a more detailed explanation of each approach.

Extract maxillary first premolars to coordinate[4,5]

In three-incisor cases, treatment options include either space closure of the missing tooth area alone, or space closure combined with extraction of the contralateral mandibular incisor, depending on the Bolton ratio and model set-up. For two-incisor cases, space closure—with or without interproximal reduction—is typically preferred, also based on Bolton analysis and digital set-up evaluation. Creating space for prosthetic replacement is generally reserved for cases exhibiting a pronounced Class II skeletal pattern.

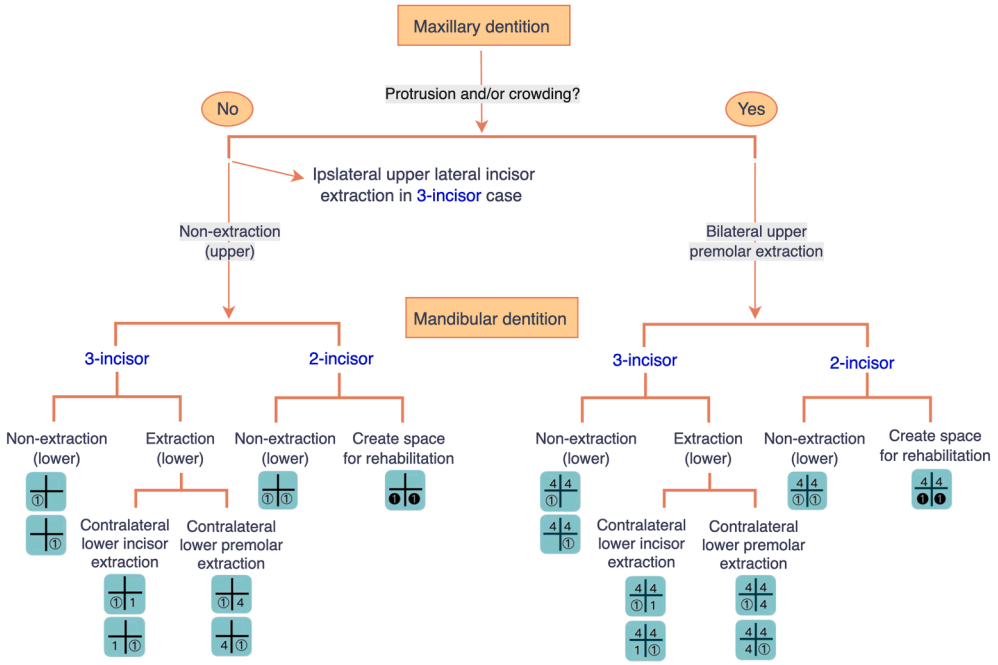

Figure 1 Palmer notation was used in this flowchart; an uncircled number indicates a tooth planned for extraction, whereas a circled number represents a congenitally missing tooth. A black-background circled number represents a congenital missing tooth planned for further rehabilitation. This flowchart outlines a general decision-making process for patients with congenitally missing mandibular incisors. However, individualized treatment planning is mandatory. For instance, in patients with a skeletal Class III pattern, a non-extraction approach in the maxilla combined with further mandibular tooth extraction may be more favorable for achieving a satisfactory result. Conversely, the bilateral extraction of maxillary bicuspids with subsequent space creation in the mandible for rehabilitation is a comparatively rare approach, typically reserved for patients with a severe skeletal Class II pattern.

Create space over lower anterior area to fabricate prosthesis[7,30–32]

Simultaneous extraction of two maxillary premolars and space creation for prosthetic replacement in the mandibular anterior region is rare and typically reserved for patients with a severe Class II skeletal pattern. When extraction of the maxillary first premolars is not indicated, the treatment approach for the mandibular dentition remains largely similar. The need for additional tooth extraction is carefully determined. If the patient presents with an occlusion approximating Angle Class I, creating space in the lower anterior region for prosthesis fabrication becomes a more favorable option.

Close the space of congenitally missing area[33,34]

Space closure in the region of congenitally missing mandibular incisors is a viable treatment option in both three-incisor and two-incisor cases, provided that satisfactory arch coordination can be achieved.

Other treatment[2]

Extraction of the ipsilateral maxillary lateral incisor has been proposed as an alternative approach in cases with a single congenitally missing mandibular incisor.[2] In the two case reports reviewed, the authors reported acceptable treatment outcomes using this method. Moreover, this approach may contribute to a shorter overall treatment duration.

In troublesome cases of congenitally missing mandibular incisors, a Bolton ratio discrepancy is often an inevitable challenge, regardless of the chosen treatment approach. Consequently, an accurate model set-up is considered a critical tool in comprehensive treatment planning. With the advancement of digital orthodontic set-up techniques, clinicians can now simulate various treatment scenarios, accurately evaluate space distribution, and determine whether the required amount of interproximal reduction falls within physiologically acceptable limits.

This platform also serves as a vital communication tool for both patients and collaborating specialists. For instance, in a three-incisor case where a simulation indicates that creating space for prosthetic rehabilitation is the ideal method for achieving optimal occlusion, a different approach may be required if the patient refuses prosthodontic treatment. In such a scenario, if the patient opts to maintain the uneven tooth number, a compromised outcome with a larger overjet and overbite must be anticipated. It is therefore essential to ensure the patient fully understands these potential compromises at the very beginning of the treatment planning process.

Furthermore, integrating cone-beam computed tomography into the planning process allows for precise assessment of the available space for future prosthetic restorations and helps determine whether the planned arch expansion is within a reasonable and safe range. These

technologies improve the predictability and precision of treatment outcomes in such complex cases.

Conclusion

Congenitally missing mandibular incisors, while relatively uncommon, present unique diagnostic and treatment challenges in orthodontics. Literature indicates that such dental anomalies are influenced by genetic, evolutionary, and developmental factors, with a higher prevalence reported in East Asian populations, particularly among Chinese and Japanese individuals. Clinically, these cases are often associated with distinctive craniofacial features, underscoring the importance of comprehensive analysis and individualized treatment planning. A treatment modality flowchart (Figure) was developed based on a collection of case reports and case series from the past several decades. Future studies employing three-dimensional imaging may offer deeper insight into the mandibular morphology and its relationship with incisor agenesis. Ultimately, orthodontists should adopt a case-specific and interdisciplinary approach to ensure functional and esthetic outcomes.

Declaration of competing interest

The authors have no conflicts of interest relevant to this article.

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