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Agenesis of Incisors: Challenges and Orthodontic Management Strategies

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ABSTRACT

Introduction: To address both functional and aesthetic issues, patients with mandibular incisor agenesis frequently seek treatment. These patient's clinical evaluation and care may deviate from our usual procedures for diagnosis and therapy planning. Agenesis of mandibular incisors is a relatively rare dental anomaly that presents unique challenges in orthodontic diagnosis, treatment planning, and long-term stability. Its aetiology is multifactorial, involving genetic, developmental, and environmental influences, and it may occur as an isolated finding or in association with syndromes.

Aims and Objectives: This article provides an in-depth overview of the condition, including its definition, classification, aetiology, and prevalence. The diagnostic process, incorporating clinical and radiographic assessment, is discussed in relation to the orthodontic implications of maxillary and mandibular incisor agenesis.

Discussion: Orthodontic management strategies are explored in detail, encompassing initial assessment, space management, treatment techniques, and the value of a multidisciplinary approach. Long-term maintenance issues, potential complications, and emerging directions in research are highlighted, aiming to provide clinicians with evidence-based strategies for optimal patient care. The purpose of this article was to examine pertinent material, highlight the need for particular attention to the quantity and location of missing maxillary and mandibular incisors, and its correlation between Agenesis & Facial /Cranial Pattern.

Keywords: Agenesis; Esthetics; Incisors; Long-term maintenance; Rehabilitation; Space management

INTRODUCTION

Dental agenesis, defined as the congenital absence of one or more teeth, represents the most common developmental anomaly affecting the human dentition. It results from a disruption in the complex interactions between genetic, epigenetic, and environmental factors during odontogenesis. While agenesis may affect any tooth, the most frequently missing teeth are third molars, mandibular second premolars, and maxillary lateral incisors. Among these, the agenesis of incisors—particularly the maxillary lateral incisors and mandibular central/lateral incisors—holds significant clinical relevance due to its esthetic, functional, and psychosocial implications.

In third molars, tooth agenesis is categorized based on the quantity of unformed teeth. Anodontia is the total lack of tooth production; hypodontia is the agenesis of one to five teeth; More severe types of dental agenesis include oligodontia and anodontia, which are distinguished by the absence of more than six teeth and, respectively, the total absence of teeth. These types are typically linked to additional systemic disorders such Ellis-van Creveld syndrome, ectodermal dysplasias, and Down syndrome.[1,2]

Given its multifactorial etiology, variable presentation, and significant impact on both dental function and facial esthetics, incisor agenesis continues to be a subject of active research and clinical debate. A comprehensive understanding of its prevalence, genetic basis, diagnostic protocols, and evolving treatment strategies is crucial for clinicians to deliver personalized and effective care.

DEFINITION AND TYPES

Agenesis of mandibular incisors refers to the congenital absence of one or more permanent mandibular incisors due to failure in tooth bud development. This condition may involve absence of one or a few teeth i.e,Hypodontia, absence of six or more teeth i.e,Oligodontia (excluding third molars) and complete absence of teeth i.e, Anodontia (rare and often syndromic).

Types based on the number and pattern include Unilateral agenesis which affects a single tooth on one side of the midline and Bilateral agenesis affecting corresponding teeth on both sides of the midline.[3]

ETIOLOGY

There are four primary views on the etiology of dental agenesis: it may be attributed to environmental or systemic factors such trauma, inflammation, infections in the jaw, or disruption of the endocrine system, or it may be seen as an expression of the evolutionary tendency. The main factor may be familial distribution or heredity. The development of tooth buds may be impacted by abnormalities in the mandibular symphysis in addition to the hypodontia of the lower incisors. Syndromic associations include ectodermal dysplasia, cleft lip/palate, Down syndrome.[4]

PREVALENCE AND IMPACT

The overall prevalence of both maxillary and mandibular incisor agenesis varies geographically, reported between 0.5%–2% in the general population, with higher rates in certain ethnic groups, particularly East Asian populations.[5]

Agenesis varies by region and gender: compared to North American Caucasians (males 3.2%; females 4.6%), the prevalence was higher for both sexes in Europe (males 4.6%; females 6.3%) and Australia (males 5.5%; females 7.6%). Africa has the highest prevalence at 13.4%, followed by Europe at 7% and Asia at 6.3%. While mandibular incisors are frequently afflicted in Asian populations. Furthermore, girls were 1.37 times more likely than males to have dental agenesis. Their smaller jaws may be the cause, as this could impede the development of tooth buds.[6-8]

DIAGNOSIS AND ASSESSMENT

Early recognition is critical, as incisor agenesis demands individualized management strategies that account for the patient's growth stage, facial profile, dental arch relationships, and long-term functional stability. An evidence-based approach involves not only the orthodontist but also a multidisciplinary team to achieve optimal outcomes. Thus, the diagnostic precision lays the foundation for a comprehensive treatment plan that addresses both immediate and long-term functional and aesthetic needs. The diagnostic process consisting of clinical examination includes inspection of dental arch form and symmetry, identification of spacing or midline deviation, assessment of overjet, overbite, and canine relationships, evaluation of gingival contour and periodontal health.[9–11]

Radiographic Assessment required for assessing orthodontic implications include panoramic radiograph which confirms absence of tooth germs, periapical radiographs that provides a detailed view for residual roots or anomalies and CBCT (if indicated) as it evaluates alveolar bone morphology and root angulation.[12–14]

ORTHODONTIC MANAGEMENT STRATEGIES

Case selection and grading of treatment difficulty involving possible indications and contraindications are the most important factors to be highlighted before management options derivation. The current indications for Clear aligner therapy are comparable to those for fixed orthodontics. Clear aligners can be used to treat nearly all types of malocclusions, especially the patients with high esthetic and comfort requirements, poor periodontal conditions, susceptibility to caries, or enamel developmental defects. However, clear aligners are not recommended for patients with clinically short crowns, requiring extensive mesial movement of the posterior teeth, or showing poor compliance.[15,16]

However, treatment difficulty of clear aligner therapy varies greatly among cases. Thus, we suggest difficulty-grading criteria for Clear aligner therapy.

Orthodontic management options and alternative modalities including a multidisciplinary approach is being inevitable in case of Oligodontia ,especially in paces where aesthetic demands have to be addressed.[17–19] A spectrum of management strategies, ranging from space closure to space maintenance with prosthetic rehabilitation, are as follows.

1. Initial Orthodontic Assessment

- Comprehensive records (study models, photographs, cephalometric analysis).
- Determination of growth stage (for timing of intervention).
- Evaluation of space requirements and occlusal goals.

2. Space Management

Two main philosophies:

- Space closure – bringing adjacent teeth together to eliminate gaps.
- Space maintenance/re-opening – preserving space for prosthetic replacement.
- Considerations include facial profile, overjet/overbite, and periodontal prognosis.

3. Treatment Techniques

- Fixed appliance therapy for controlled tooth movement and space distribution.
- Interproximal reduction for improved tooth size coordination.
- Composite buildups to enhance aesthetics of retained primary teeth.
- Prosthetic rehabilitation (resin-bonded bridge, implant placement) if space is maintained.

4. Multidisciplinary Approach

Optimal outcomes require collaboration between:

- Orthodontist – space management and occlusal alignment.
- Prosthodontist – design of aesthetic replacements.
- Periodontist – soft tissue contouring and bone preservation.
- Pediatric dentist – interim restorations in growing patients.

5. Long-Term Management and Challenges

- Retention phase – prolonged retention with bonded lingual retainers to prevent relapse.
- Growth considerations – implants deferred until skeletal maturity.
- Periodontal health – careful monitoring due to altered contact points and potential bone loss.
- Occlusal stability – risk of shifting if replacement or closure is not well maintained.

CLINICAL INSTANCES :

A number of clinical instances that showed differences in anterior teeth that are absent from birth. A 19-year-old female (Figure 1), had a leptoprosopic facial pattern, a dolichocephalic head pattern, and a straight profile. Intraoral results indicated spacing in the lower anterior region, for which orthodontic bonding of the lower arch was started, and radiographic evaluation revealed congenitally absent mandibular lateral incisors (32 and 42). Bonding of the lower arch was used to treat another female patient of 15-year-old (Figure 2) with a convex profile and a similar craniofacial pattern who had a congenitally absent mandibular right lateral incisor (42), which was also linked to crowding in the lower anterior region due Arch-length discrepancy.

CASE 1:

Figure 1: (a)19-year-old Female patient with straight profile, Dolicocephalic head pattern and Leptoprosopic facial pattern.(b)Radiographic analysis showed congenitally missing 42 and 32.(c) Intraoral images revealed spacing in lower anteriors with missing 32 and 42 . (d) Initial bonding photos of lower arch.

CASE 2 :

Figure 2: (a)15-year-old Female patient with convex profile, Dolicocephalic head pattern and Leptoprosopic facial pattern.(b)Radiographic analysis showed congenitally missing 42.(c) Intraoral images revealed Crowding in lower anteriors with missing 42. (d) Initial bonding photos of lower arch.

CASE 3 :

Figure 3: (a)25-year-old Male patient with convex profile, Dolicocephalic head pattern and Leptoprosopic facial pattern.(b)Radiographic analysis showed congenitally missing 31 and 41.(c) Intraoral images revealed Crowding in lower anteriors with missing 31 and 41 with retained deciduous 71 73 and 81. (d) Initial bonding photos of lower arch.

A 25-year-old male patient (Figure 3) with a convex profile showed crowding and retained deciduous teeth (71, 73, and 81) along with congenitally absent mandibular central incisors (31 and 41). After a clinical and radiographic evaluation, orthodontic intervention was started by extraction of retained deciduous teeth followed by prosthetic rehabilitation after orthodontic management.

A congenitally absent mandibular left lateral incisor (32) and crowding in the lower anterior region were present in another 25-year-old female patient (Figure 4) with a straight profile; treatment progress was recorded up to the pre-debonding stage. In a similar vein, a 23-year-old male patient (Figure 5) with a straight profile showed space in the upper anterior region as a result of a missing laterals.

CASE 4

Figure 4: (a)25-year-old Female patient with Straight profile, Dolicocephalic head pattern and Leptoprosopic facial pattern.(b)Radiographic analysis showed congenitally missing 32.(c) Intraoral images revealed Crowding in lower anteriors with missing 32 (d) Initial bonding photos of lower arch.(e) Predebonding Photos

A more complicated case involved a 17-year-old female patient (Figure 6) with a straight profile who had several congenitally missing teeth (12, 22, 31, 33, and 41), which caused considerable spacing in the anterior maxillary and mandibular regions. Together, these instances demonstrate the variation in anterior tooth agenesis clinical presentation and the corresponding orthodontic therapy strategies based on unique skeletal pattern, spacing, and crowding features.

CASE 5:

Figure 5: (a)23-year-old Male patient with Straight profile, Dolicocephalic head pattern and Leptoprosopic facial pattern.(b) Intraoral images revealed Spacing in upper anteriors with missing 12 and 22 (d) Initial bonding photos.(e) Predebonding Photos

CASE 6:

Figure 6: (a)17-year-old female patient with Straight profile, Dolicocephalic head pattern and Leptoprosopic facial pattern (b) Intraoral images revealed Spacing in lower anteriors with missing 12 22 31 33 41

DISCUSSION

According to the orthodontic literature, there are four primary ideas as to why mandibular incisors go missing: The main explanation has been proposed to be familial distribution or heredity. According to Graber et al, "Congenital partial anodontia appears to be the result of one or more-point mutations in a closely linked polygenic system, most often transmitted in an autosomal dominant pattern incomplete penetrance and variable expressivity." He further stated, "It is the dental clinician's challenge to recognize the congenital absence of teeth and evaluate other family members for possible manifestations of this primarily heritable condition."[20]

According to an article in the July 1967 issue of the American Journal of Orthodontics by Newman et al, one of the potential causes could be heredity or a familial distribution of congenitally absent mandibular incisors. Patients with two congenitally absent mandibular incisors were described in this paper.[21]

The dental tissues that create the lower incisors' tooth buds may be impacted by abnormalities in the mandibular symphysis' development. Some scholars believe that a decrease in dentition is nature's attempt to accommodate the shorter dental arches, which is a manifestation of the evolutionary trend.[22]

Several recent case reports illustrate innovative, multidisciplinary solutions. For example, lingual appliance techniques with canine substitution have been used to achieve excellent aesthetic and functional outcomes in adults with single mandibular incisor agenesis, while combination therapy using orthodontics (including Herbst mechanics for space redistribution) followed by implant prosthodontics has been described for complete mandibular incisor agenesis to harmonize occlusion and restore anterior aesthetics. These case-level data underline the need for flexibility in treatment sequencing and indicate that skeletal anchorage, interproximal recontouring, and restorative reshaping can all be part of a successful plan.[23,24]

Reidel talked on whether to remove one or two mandibular incisors to address specific malocclusions. In other situations, he recommended removing the maxillary first premolars and laterals to balance the tooth structure. He adds that in order to create a harmonious tooth relationship between these five teeth and the maxillary six anterior teeth, the mandibular incisors may need to be re-approximated or trimmed.[25]

According to Lalitha Priya et al, the following are the three common treatment options described in the literature managing congenitally missing of mandibular incisors:

1) Therapeutic extraction of maxillary first premolars to compensate for the missing mandibular incisor.
2) Moving the posterior teeth forward in the mandibular arch.
3) Creating space for prosthetic rehabilitation.[26]

From an orthodontic and morphological perspective, mandibular incisor agenesis can alter arch form and mandibular symphyseal dimensions, especially in bilateral absence. Several clinicopathologic reports and systematic reviews have shown that missing anterior mandibular teeth may result in space discrepancies, midline deviations, and modified incisor angulations that affect anterior guidance and occlusal function. These effects are amplified during growth: untreated discrepancies tend to manifest as compensatory dental drift and can complicate later restorative options (for example, when alveolar bone resorption narrows the site for future implants). Therefore, early and accurate documentation (clinical records and radiographs) is essential to guide timing and modality of intervention.[27]

FUTURE DIRECTIONS AND RESEARCH

The advent of digital dentistry, 3D imaging, and CAD/CAM technology has already begun to transform diagnosis, treatment planning, and appliance fabrication in these cases. Similarly, regenerative dentistry, particularly stem cell-based tooth germ bioengineering offers the prospect of biological tooth replacement, potentially eliminating the need for prosthetic substitutes altogether(Organ-Germ method).[28–30]

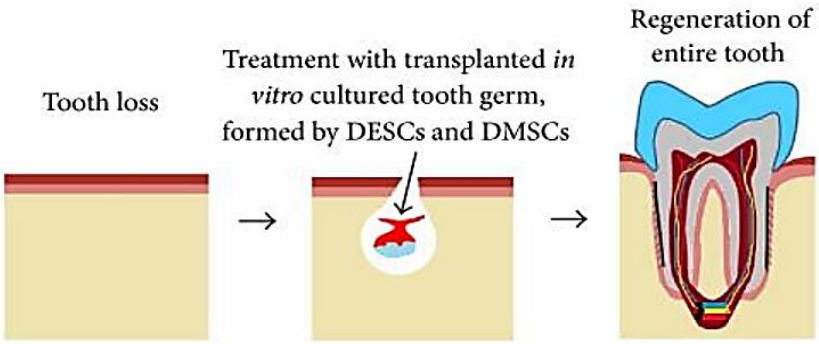

Figure 7: Tooth germ auto-transplantation as a treatment option[29]

Previous studies of autologous tooth germ transplantation, showing that this process prevented immunological rejection after transplantation, have reported successful tooth eruption into the oral cavity and restoration of physiological tooth function. Further changes in morphology can be performed in future to build into the anticipated incisor.[29,31]

Advances in biomaterials for adhesive bridges and implant-supported restorations continue to improve longevity and tissue compatibility, while skeletal anchorage innovations expand the scope of orthodontic space closure mechanics. Genetic profiling to predict susceptibility and guide preventive counselling,3D printing and digital smile design for precision prosthetic planning, bioengineered tooth regeneration as a potential definitive solution. Long-term clinical trials comparing outcomes of space closure vs. prosthetic replacement are anticipated to outperform modalities which have been followed conventionally. Against this backdrop, the following section examines emerging trends, technological innovations, and research priorities that hold the potential to redefine how clinicians approach the diagnosis and management of incisor agenesis in the coming decades.

CONCLUSION

Agenesis of incisors, although relatively rare, demands meticulous diagnosis and tailored treatment planning to address functional, aesthetic, and psychosocial concerns. The choice between space closure and space maintenance must be individualized, factoring in growth status, occlusal harmony, and patient preference. A coordinated multidisciplinary approach is key to achieving stable, aesthetic, and functional outcomes. Advances in genetics, biomaterials, and digital dentistry hold promise for transforming future management paradigms in this domain.

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DATA AVAILABILITY STATEMENT:

The data supporting the findings of this study are not publicly available due to patient confidentiality but are available from the corresponding author upon reasonable request.

INFORMED CONSENT AND ETHICAL APPROVAL STATEMENT

Informed consent has been obtained from all the patients subjected in this study, which was produced to Institutional Ethical Clearance Board (ECR/1742/APDCH/ORTHO/07/TN2025)

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