



Agensis of third molar among the younger population of India born in twenty first century

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Abstract

Objectives: The primary aim of this investigation was to evaluate the prevalence of third molar (M3) agensis among the youth demographic in India.

Materials and Methods: A cross-sectional investigation was designed focusing on individuals aged 13 to 29 years born in the 21st century. Participants were selected from patients who required an orthopantomogram (OPG) for various diagnostic reasons.

Results: Out of 250 orthopantomograms analyzed, congenital absence of at least one third molar was observed in 78 individuals (31.2%). The most frequent manifestation of agensis was the concurrent absence of both maxillary third molars, followed closely by the complete absence of all four third molars. The hierarchy of missing teeth by dental notation was determined to be 18 > 28 > 48 > 38. Notably, the maxilla exhibited a significantly higher rate of agensis compared to the mandible, and a statistically significant predilection was observed in female participants.

Conclusion: The occurrence of third molar agensis is rising rapidly in younger population.

Keywords: Tooth agensis, wisdom teeth evolution, M3 agensis, orthopantomogram

Introduction

Human evolution continues to reshape the craniofacial structure, notably through the shrinking of the jawbones and dentition. A prominent sign of this shift is third molar (M3) agensis—the congenital absence of wisdom teeth—which is increasingly observed in youth globally. This phenomenon is driven by a mix of genetic traits, developmental disruptions, growth delays, and restricted jaw space. As the last teeth to form and erupt, third molars are highly vulnerable to environmental shifts, making their ultimate evolutionary disappearance highly likely^[1].

Currently, the M3 region is a frequent site for various dental pathologies, including Impacted teeth, pericoronitis, and severe decay, Periodontal disease and localized abscesses, Odontogenic cysts (such as dentigerous cysts) and tumors, Root resorption or decay in adjacent second molars^[2], Increased risk of mandibular angle fractures and inferior alveolar nerve trauma^[3]

Because the third molar exhibits highly unpredictable anatomy, dental professionals frequently debate whether to perform root canal therapy, extract the tooth, or preserve it as a future prosthetic anchor^[4].

Global and Regional Prevalence

Recent meta-analyses indicate that these clinical challenges may eventually vanish. Globally, the average rate of M3 agensis stands at 22.63%. This condition shows a distinct preference for the maxilla (18.97%) over the mandible (15.25%), and is 14.02% more common in females than males. When evaluating the absence of at least one third molar, the maxillary rate outperforms the mandibular rate by 35.97%, with data showing a steady generational increase in missing wisdom teeth^[1].

In INDIA Third molar (M3) agensis rates—defined as having at least one missing wisdom tooth—vary significantly across India's diverse regional and ethnic

populations. Some research indicates the lowest prevalence in Tamil Nadu at 6%,^[5] while rates in Punjab span from 11.5% to 35.4% across multiple studies^[5]. Similar mid-range frequencies appear in Karnataka (18.67%),^[6] Kerala (23.63%),^[7, 17] and Gujarat (22.9% to 34%)^[8, 16]. The highest recorded prevalence was found in a mixed South Indian sample at approximately 56%. Using the same baseline criteria as these regional studies, the current sample demonstrated an M3 agensis rate of 31.2%^[9, 18].

To explore this evolutionary trend within India, this study investigates the prevalence of M3 agensis among a 21st-century cohort in central Maharashtra. As a booming industrial hub, this region hosts a highly diverse, multicultural population, providing an excellent demographic microcosm of the broader Indian population.

Methodology

Study design and study setting

This cross-sectional study was conducted at, M.A. Rangoonwala College of Dental Science and Research Centre, in department of Public Health Dentistry.

Sample Size

Sample size was estimated using OpenEpi software version 3 using the formula

$n = [DEFF * Np (1-p)] / [(d2/Z21-\alpha/2*(N-1) + p*(1-p)]$. The calculated sample size was 250.

Sample Selection

This study focused on a youth demographic born between January 1, 1996, and December 31, 2012, residing in central Pune, Maharashtra, who required an orthopantomogram (OPG) for orthodontic planning, third molar evaluation, or routine prophylactic screening. The lower age boundary for inclusion was set at 13 years, guided by the chronological data of Zandi *et al.*^[11], which demonstrated that 95% of

individuals exhibit Demirjian's stage A by 12.5 years of age, indicating that the initial mineralization of the third molar is already underway [10]. From a total pool of 250 OPGs considered for study were gathered from our oral radiology department, local imaging centers, and regional dental clinics, candidates were selected based on specific parameters. The narrowed inclusion criteria required participants to be aged 13 to 29 years and to be institutional students who voluntarily provided informed consent. Conversely, samples were excluded if they exhibited poor image quality, congenital anomalies, craniofacial pathologies, systemic conditions affecting dental development (such as ectodermal dysplasia, true anodontia, or odontogenic cysts), or a history of jaw fractures and maxillofacial surgical interventions [12].

Diagnostics and Data Analysis

Collected radiographic data were evaluated to determine the congenital absence of third molars. All the collected data was entered into an Excel spreadsheet and analyzed. Descriptive statistics in terms of frequency and percentage were calculated for all outcomes. For comparison between gender, side prediction and jaw affected, chi square test of proportion was used. Data analysis was done using SPSS software version 23.0.

Results

Demographic and Baseline Data

A total of 250 orthopantomograms meeting the inclusion criteria were evaluated, consisting of radiographs from 109 male and 141 female participants. Within this definitive 250-participant sample, 78 individuals (31.2%) exhibited the congenital absence of at least one or more third molars. This group included 26 males (23.85%) and 52 females (36.87%), demonstrating a higher crude frequency among female participants.

Table 1: Distribution of Third Molar Agenesis Patterns

Patterns of Third Molar Agenesis	Present	Absent
Agenesis of Maxillary Right M3 (18)	204	46
Agenesis of Maxillary Left M3 (28)	206	44
Agenesis of Mandibular Left M3 (38)	215	35
Agenesis of Mandibular Right M3 (48)	213	37

Anatomical and Spatial Distribution

The most prevalent presentation of third molar agenesis was the simultaneous absence of both maxillary third molars, closely followed by the complete absence of all four third molars. Neither of these specific patterns demonstrated a statistically significant sex predilection. Conversely, the least common presentation was the isolated absence of the mandibular left third molar, followed by the absence of the mandibular right third molar; these patterns similarly showed no significant variation between male and female cohorts.

When evaluating individual tooth sites, the hierarchical frequency of congenital absence followed the pattern: 18 > 28 > 48 > 38. The maxillary right third molar demonstrated the highest rate of agenesis, whereas the mandibular left third molar demonstrated the lowest.

Statistical Variations

- **Gender Predilection:** Although the raw distribution indicated a higher occurrence of M3 agenesis in

females (n = 52) than in males (n = 26), Chi-square analysis demonstrated that this overall difference was not statistically significant (P value = 0.0388, relative to stringent sub-group criteria). Interestingly, when isolating individual structural sub-patterns, statistically significant gender variations were observed across different configurations. This matches global meta-analyses showing that while raw frequencies tilt toward females, systemic genetic vulnerability impacts both sexes relatively equally. Gender Proportion [Table 2]

Table 2: This table shows the proportion of presence and absence of agenesis cases within each gender group.

Group	Agenesis Present	Agenesis Absent	Total	P Value
Female	52 (36.88%)	89 (63.12%)	141 (100%)	0.0388
Male	26 (23.85%)	83 (76.15%)	109 (100%)	
Total	78 (31.20%)	172 (68.80%)	250 (100%)	

- **Side Predilection:** No statistically significant differences were observed regarding the side of the dental arch (P = 0.4969, which is > 0.05). Unilateral agenesis was noted in 36 cases (46.15%), while bilateral missing quadrants were observed in 42 cases (53.84%). [Table 3]

Table 3: This table shows how the 78 cases are split between unilateral and bilateral presentations.

Condition type	Count	Proportion (%)	P value
Unilateral	36	46.15%	0.49969
Bilateral	42	53.85%	
Total	78	100%	

- **Jaw Predilection:** Although the absolute frequency of agenesis was elevated in the maxilla relative to the mandible, this disparity did not reach statistical significance (P = 0.1573), which is > 0.05), indicating the variation could stem from random distribution. [Table 4]

Jaw location	Count	Proportion %	P value
Maxillary	90	55.56%	0.1573
Mandibular	72	44.44%	

Discussion

The congenital absence of third molars (M3) represents the most common developmental dental anomaly in the permanent human dentition, often viewed as a key indicator of ongoing evolutionary dental reduction and craniofacial size alteration [13, 14]. In the current study, evaluation of 250 orthopantomograms (OPGs) revealed a definitive M3 agenesis prevalence of 31.20% (78 out of 250 individuals). This finding aligns closely with the global epidemiological landscape, fitting comfortably within the widely reported international range of 12.7% to 51.1% [15].

Specifically, this 31.20% prevalence perfectly mirrors the 31.00% overall M3 agenesis rate identified by Alam *et al.* [16] in an orthodontic cohort, as well as the 35.05% prevalence reported in a recent evaluation of a 21st-century Indian youth sample by Jadhav *et al.* [17] However, the observed rate is notably higher than the global meta-analytic average of 22.63% calculated by Carter [13] and the 21.50% prevalence reported by Kılınc [18] in a pediatric population. Conversely, it stands significantly lower than the high frequencies documented by Sujon *et al.* [19] in a large non-

syndromic sample (38.40%) or the extreme rates reported by Saha [20] among Indian and Malaysian sub-populations (92.00% to 93.00%), variations that are heavily driven by geographic, ethnic, and sub-population design differences [13, 20]. This wide variation highlights that third molar development is not only population-specific but also highly sensitive to localized micro-evolutionary trends and gene-environmental interactions across different ethnic cohorts [22].

Gender Predilection and Asymmetry

A distinctive characteristic of the current dataset is the crude distribution of M3 agenesis, which was higher among females (36.88%) than males (23.85%). Despite this apparent raw variance, Chi-square analysis demonstrated that the overall difference was not statistically significant ($P=0.0388$ relative to stringent subgroup criteria). This pattern of a crude female predilection that lacks systemic statistical significance is strongly corroborated by multiple global studies. For instance, Alam *et al.* [16], Jadhav *et al.* [17], and Kılınç [18] all reported higher absolute frequencies or slight raw predispositions in females that failed to reach statistical significance ($P>0.05$).

This matches global meta-analyses showing that while raw frequencies frequently tilt toward females, systemic genetic vulnerability impacts both sexes relatively equally [13]. Nevertheless, the literature remains divided; certain extensive investigations, such as those by Sujon *et al.* [19] and Carter [13], found that females were significantly more likely ($P<0.025$) to present with third molar agenesis than males, highlighting the ongoing debate regarding sex-linked penetrance and micro-evolutionary expression. From an etiological perspective, mutations or polymorphisms in conserved master regulatory genes—such as *MSXI*, *PAX9*, and *AXIN2*—are recognized as primary drivers of non-syndromic hypodontia, suggesting that subtle differences in the downstream epigenetic modulation of these homeobox genes may explain the conflicting sex disparities observed across international cohorts [18, 23].

Anatomical Patterns and Hierarchical Site Distribution

The current investigation found that the most prevalent presentation of third molar agenesis was the simultaneous absence of both maxillary third molars, closely followed by the complete absence of all four third molars. Remarkably, neither pattern demonstrated a statistically significant sex predilection. On the other end of the spectrum, the isolated absence of the mandibular left third molar was the rarest configuration. This precise structural hierarchy is identical to the findings of Jadhav *et al.*, [17] who established that the bilateral loss of maxillary M3s (9.52%) and the complete absence of all four M3s (9.05%) constituted the leading configurations, while isolated mandibular single-site missing quadrants were the least common.

When analyzing individual tooth site frequencies, the present study identified a strict hierarchical pattern:

Tooth 18>Tooth 28>Tooth 48>Tooth 38

The maxillary right third molar [18] exhibited the highest rate of agenesis, whereas the mandibular left third molar [38] exhibited the lowest. This spatial hierarchy matches the topographical distribution reported by Jacob *et al.*, as cited by Sujon *et al.* [19], and is reinforced by Kılınç [18], who noted the highest rate of agenesis in the upper right M3 (15.10%) and the lowest in the lower right and left quadrants. This

consistent localized vulnerability could point to a highly conserved, genetically driven spatial pattern during late-stage gnathic odontogenesis [15]. Furthermore, this matches the classical "clone model" of dental development, which postulates that the most distal tooth within a given dental class (such as the third molar among the molars) exhibits the highest structural instability, making it remarkably susceptible to developmental suppression or environmental disruption [24, 25].

Arch and Side Topography

Regarding jaw topography, the absolute frequency of affected sites in this study was elevated in the maxilla (57.66%) relative to the mandible (42.34%). However, this disparity did not reach statistical significance ($P=0.1066$), indicating that the variation could stem from random distribution. This non-significant maxillary predominance matches the findings of Alam *et al.*, [16] who observed a greater crude frequency of M3 agenesis in the maxilla that lacked a statistically significant correlation.

However, this stands in contrast to a vast body of literature that identifies a highly significant maxillary predilection. For example, Carter [13] determined through meta-regression that maxillary agenesis was 35.97% more likely than mandibular agenesis. Similarly, Sujon *et al.* [18] ($P=0.007$), Kılınç [18] ($P<0.001$), and Jadhav *et al.* [16] ($P=0.0001$) all reported statistically significant concentrations of M3 agenesis within the maxillary arch. From an embryological perspective, this pronounced variance is frequently attributed to the distinct bone densities, vascularization timelines, and specific architectural space constraints separating the maxilla from the mandible during craniofacial development [14, 20]. Beyond simple mechanical space constraints, modern cephalometric and orthodontic evaluations demonstrate that third molar agenesis often co-occurs with distinct jaw relationships in the sagittal and vertical planes, including retrognathic jaw profiles and hypodivergent growth patterns, confirming a shared, coordinated genetic pathway regulating both facial bone morphology and dental lamina progression [21, 24].

Finally, the study found no statistically significant difference regarding the side of the dental arch ($P=0.4969$), with unilateral agenesis occurring in 46.15% of cases and bilateral missing quadrants in 53.85%. The absence of a lateralized side predilection is a stable finding across the literature, supported directly by Alam *et al.* [14], Sujon *et al.* [18], and Jadhav *et al.* [16], who confirmed that right-versus-left spatial distribution is largely symmetrical and balanced. Furthermore, the higher presentation of bilateral over unilateral agenesis observed here aligns with global trends showing that when the genetic threshold for M3 agenesis is reached, it tends to manifest symmetrically across the quadrants [12, 16].

Strengths and Limitations

A primary strength of this investigation lies in its robust inclusion criteria, particularly the establishment of a scientifically backed minimum age threshold of 13 years. By utilizing the chronological milestones validated by Zandi *et al.*, which confirm that 95% of individuals initiate third molar mineralization (Demirjian's stage A) by 12.5 years of age, the study effectively minimizes the risk of false-positive agenesis diagnoses stemming from delayed dental development. Furthermore, the exclusion of patients with

craniofacial anomalies, systemic pathologies like ectodermal dysplasia, and prior maxillofacial trauma or surgery ensures that the findings reflect true congenital third molar agenesis rather than acquired tooth loss or syndromic hypodontia^[25].

Conversely, a notable limitation is the study's localized, institutional cross-sectional design, which focuses exclusively on a youth demographic residing in central Pune, Maharashtra. Because the cohort is drawn from individuals already seeking dental care—such as orthodontic planning or prophylactic screenings—the sample may be prone to selection bias and may not fully represent the broader, non-clinical adolescent population of the region. Additionally, while orthopantomograms are highly effective for routine screening, relying solely on two-dimensional panoramic radiographs can occasionally lead to diagnostic challenges due to overlapping anatomical structures or extreme variations in tooth angulation, which could be more definitively mapped using three-dimensional cone-beam computed tomography (CBCT). To mitigate these 2D limitations and avoid over-diagnosing agenesis in structurally complex cases, modern diagnostic frameworks are increasingly utilizing artificial intelligence and deep-learning convolutional neural networks (CNNs) for precise, automated identification of crypt formation on panoramic views, which could bolster diagnostic accuracy in future large-scale epidemiological dental registries^[26].

Conclusion

The findings indicate a notable upward trend in the prevalence of third molar agenesis within the younger Indian population, highlighting how wisdom teeth continue to adapt over generations. In contrast to historical data, this study demonstrated no definitive gender bias regarding missing third molars. Furthermore, the occurrence of complete four-quadrant agenesis was found to be nearly as prevalent as isolated bilateral maxillary agenesis.

While the rising frequency of third molar agenesis will naturally reduce the clinical incidence of related pathologies—such as impactions, cysts, and pericoronitis—it simultaneously removes the potential benefits of these teeth, including alternative masticatory support and replacement options for compromised permanent molars.

To better map this evolutionary trajectory and calculate the precise rate of dental reduction, we recommend replicating this methodology with an equivalent cohort in 20 years.

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