

PREVALENCE AND DISTRIBUTION OF THIRD MOLAR AGENESIS IN AN ADULT NORTH INDIAN POPULATION: A RETROSPECTIVE PANORAMIC RADIOGRAPHIC STUDY

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Abstract

Background: Third molar (M3) agenesis is the most frequently observed form of dental agenesis and is believed to result from a combination of genetics, evolutionary and environmental factors.

Aim: To determine the Prevalence and distribution of third molar Agensis among adults using panoramic radiographs (orthopantomograms or OPG).

Methods: A retrospective cross-sectional study was conducted on 1,670 digital OPGs of adults aged 18-60 years. The presence or absence of third molars in all four quadrants was assessed and analyzed using the chi-square test to determine associations with age and gender.

Results: Third molar agenesis was commonly observed in a substantial proportion of the study population. The absence of a single third molar was the most frequent pattern, followed by bilateral and complete agenesis. Tooth 28 exhibited the highest prevalence of agenesis among males, whereas tooth 38 was more frequently absent among females. A significant association was observed between age group and third molar agenesis ($p < 0.001$), while gender-related differences were not statistically significant.

Conclusion: Third molar agenesis is a common developmental variation influenced by multiple biological and evolutionary factors like age, gender etc. knowledge of its prevalence and distribution can assist clinicians in diagnosis, treatment, planning, and understanding patterns of dental development.

Keywords: Third Molar, Agensis, Dental development, Panoramic radiography, Orthopantomogram

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Introduction

Dental agenesis is one of the most common developmental anomalies of the human dentition and is characterized by the congenital absence of one or more teeth. Among permanent teeth, third molars exhibit the highest prevalence of agenesis and considerable variation in eruption patterns across populations (Angelakopoulos N, et al.2026). The etiology of third molar agenesis is multifactorial, involving genetic regulation, environmental influences, evolutionary adaptations, and craniofacial growth patterns. Contemporary evolutionary theories suggest that reductions in jaw size and changes in dietary habits have contributed to the increasing prevalence of third molar absence in modern populations (Jadhav AN, Shaikh SS,et al.2024).

Understanding the prevalence and distribution of third molar agenesis is clinically important for orthodontic treatment planning, oral surgical procedures, forensic age estimation, and anthropological research (Khalaf K, Miskelly J, Voge E, et al.2023).

Materials and Methods

This retrospective cross-sectional radiographic study was conducted from october 2025 to july 2026 in the Department of Oral Medicine and Radiology at Pacific Dental College & Research Centre, Udaipur, Rajasthan.

Sample Size and Population

The study included 1,670 adult patients (both males and females) between the ages of 18 to 60 years. Patients selected from those attending the outpatient

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department (OPD) for reasons unrelated to third molar pathology. The sample size was calculated using Open Epi v3.0 at a 99.5% confidence interval and 80% power.

Sample size formula: $n = Z^2 \times p \times (1-p) / e^2$

Where:

$Z = 2.807$ (for 99.5% CI),

$p = 0.505$ (estimated prevalence),

$e = 0.05$ (margin of error).

Although the minimum calculated sample size was 788 participants, a total of 1,670 eligible panoramic radiographs were included to improve statistical precision and population representation

Inclusion Criteria

- All the panoramic radiographs of healthy individual of age above 18-60 years
- Apart from M3, all molars should be present
- Availability of adequate radiographic evidence to determine the presence or congenital absence of third molars.
- One or more teeth missing anterior to premolar were taken
- Only good quality digital panoramic radiographs were used.

Exclusion Criteria

- Age below 18 years.
- History of extraction of third molars.
- Radiographs with poor image quality, ghost images, or artifacts.
- Patients with systemic diseases, congenital disorders, or jaw pathologies (e.g., cysts, tumors, fractures).
- H/o surgery involving posterior quadrants of both jaws.
- Pregnant females

Methodology

- The detailed case history was recorded of each selected subject, & radiographic analysis was performed using Kodak 8000C digital OPG/ Cephalometric machine under standardized conditions. All radiographs were evaluated quadrant-wise to assess the presence or absence of third molars
- Radiographs were reviewed independently by two oral radiologists.
- Cases were categorized based on the number of missing third molars: One missing, Two missing, Three missing, All four missing.

Statistical Analysis

Data were entered into Microsoft Excel and analyzed using SPSS v26.0. Chi-square tests were used to evaluate associations between third molar agenesis, gender, and age groups A p-value of less than 0.05 was considered statistically significant.

Results

1. Prevalence of Third Molar Agensis

The most common pattern was the absence of a single third molar, followed by bilateral Or complete agenesis

The results were statistically significant with a p-value = 0.000481, indicating a strong prevalence of agenesis in the study population.

2. REGION WITH THE HIGHEST PREVALENCE OF MISSING THIRD MOLARS

Tooth-specific analysis revealed:

- Tooth 28 (left maxillary third molar) was most commonly missing in males
- Tooth 38 (left mandibular third molar) was most frequently missing in females

Despite these trends, the difference in missing teeth by jaw region and gender was not statistically significant ($p = 0.097$).

3. Correlation with Age and Gender

Age (in year)	Gender	One M3 Missing	Two M3 Missing	Three M3 Missing	Four M3 Missing	All M3 Present
18 - 30	M(530) F(359)	110(20.8%) 60(16.7%)	28(5.3%) 13(3.6%)	19(3.6%) 34(9.5%)	40(7.5%) 22(6.1%)	333(62.8%) 230(64.1%)
31 - 40	M(267) F(109)	54(20.2%) 09(8.3%)	55(20.6%) 32(29.4%)	27(10.1%) 00	04(1.5%) 00	127(47.6%) 68(62.3%)
41 - 50	M(221) F(40)	50(22.6%) 00	36(16.3%) 00	00 04(10.0%)	15(6.8%) 09(22.5%)	120(54.3%) 27(66.5%)
51 - 60	M(108) F(36)	24(21.2%) 09(25.0%)	04(3.7%) 09(25.0%)	09(8.3%) 13(36.1%)	13(12.0%) 00	58(53.7%) 05(13.9%)

Statistical analysis confirmed that this correlation was highly significant with a p-value <0.001.

Discussion

The present study evaluated the prevalence and distribution of agenesis in a northern Indian adult population using OPG. The findings revealed that M3 agenesis is relatively common, with the absence of single third molar being the most frequent presentation, followed bilateral and complete agenesis

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(Angelakopoulos et al., 2026.). These results align with previous literature suggesting that third molars exhibit the highest rate of agenesis among all Permanent teeth due to a combination of genetic, evolutionary, and environmental influences (Kavadia et al., 2011; Carter & Worthington. 2015). The observed pattern of M3 agenesis, with tooth 28 (left maxillary) being most frequently missing in males and tooth 38 (left mandibular) in females (Angelakopoulos et al., 2026.), is consistent with earlier studies reporting Site- and gender-specific variations (Gomes et al. 2010; Endo et al., 2015). Although these trends were not statistically significant in the present study, they may reflect subtle differences in jaw growth patterns, eruption sequences, and genetic determinants between sexes.

The etiology of third molar agenesis is considered multifactorial, involving genetic, environmental, and developmental influences. Previous studies have implicated genes such as PAX9, MSX1, AXIN2, and WNT10A in disturbances of odontogenesis, supporting the concept that agenesis represents a genetically regulated developmental variation rather than an isolated dental anomaly (Khalaf et al., 2023). From an evolutionary perspective, the findings support the theory of a gradual reduction in jaw size and masticatory demands in modern humans (Evans et al., 2012). With the advent of softer diets and advanced food processing, the need for robust posterior dentition has diminished, leading to a decline in the prevalence of fully erupted third molars and an increase in agenesis. This trend has been observed globally, although prevalence rates vary across populations with Asian populations often showing higher rates than African and European groups (Celikoglu et al. 2010;Nanda Kaushik, 2017).

The strong correlation between M3 agenesis and age group ($p < 0.00001$) suggests that agenesis detection may be influenced by developmental timing and radiographic assessment. Younger age groups (18-30 years) showed a higher prevalence of single missing third molars, while older groups exhibited greater proportions of multiple agenesis (Angelakopoulos et al., 2026.). This could reflect differences in detection due to tooth bud visibility or variations in sample composition over age ranges

Limitations of the study include its retrospective design and the reliance on OPG, which may have inherent imaging distortions. Additionally, the study did not incorporate genetic analysis, which could provide deeper insight into the hereditary nature of M3 agenesis

Conclusion

Third molar agenesis represents a common developmental variation within the studied North Indian population. The absence of a single third molar

was the predominant presentation, and age showed a significant association with agenesis patterns. These findings contribute valuable epidemiological data that may assist clinicians in diagnosis, orthodontic treatment planning, oral surgical management, and the broader understanding of human dental evolution. Further multicentric and genetic studies are warranted to clarify the biological mechanisms underlying third molar agenesis.

Future Scope

Future research should focus on genetic correlations to identify hereditary factors, longitudinal studies to track developmental patterns, and comparative analyses across different populations. Clinically, understanding agenesis can improve orthodontic and surgical planning, while anthropological insights may help explain craniofacial adaptations linked to changing diets and lifestyles. Such investigations would strengthen both clinical practice and evolutionary research.

Data Availability

Author Contributions

- Dr. Vikas Kumar: [Conceptualization, Investigation, Collected data, Writing - Original Draft]
- Dr. Anshuman Jamdade: [Academic Supervision, and overall guidance for research work]
- Dr. Satyapal Yadav: [Academic Supervision]
- Dr. Neeraj Kumar: [Academic Supervision]
- Dr. Haritma Nigam: [Data Collection, reviewed the manuscript]
- Dr. Nidhi Yadav: [Analyzed Data Curation, Validation, Visualization, reviewed the manuscript, Critical feedback, final approval of manuscript]

Conflict of Interest

The authors declare that they have no competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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