

Radiographic Assessment of Third Molars Agenesis Patterns in Young Adults

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ABSTRACT

Objective: To determine the prevalence of third molar agenesis and associated characteristics. **Material and Methods:** A total of 2374 panoramic radiographs were retrieved from the radiological archives and evaluated in a computer monitor under optimum viewing conditions. The basic demographic data (age and sex) and the primary findings regarding the presence or absence of third molars in the maxillary and mandibular arches were recorded systematically in a specially designed proforma. Categorical variables were compared using the Chi-square test. **Results:** A total of 2000 panoramic radiographs were included in the study, of which 1004 were females (50.2%), and 996 were of males (49.8%). The incidence of third molar agenesis was 486 patients (24.3%). Maxillary third molar showed a higher prevalence of agenesis (28.8%) than mandibular third molars (16.4%). A total of 1514 patients (75.7%) had third molars in all four quadrants, and the remaining 486 patients (24.3%) had agenesis of third molar tooth in at least one of the quadrants. Single tooth agenesis was observed in 219 (11%) patients, two teeth agenesis in 172 (8.6%) patients, three teeth agenesis in 39 (2%) patients, and four teeth agenesis in 56 (2.8%) patients. **Conclusion:** The present study exhibited a maximum number of single tooth agenesis. It was also observed that maxillary third molar agenesis is more than the mandibular third molar and the right side is more than the left side. Agenesis of the third molar is more prevalent in males as compared to females.

Keywords: Molar, Third; Tooth Abnormalities; Anodontia; Prevalence.

Introduction

The process of evolution has resulted in a gradation of changes in the ecosystem, including humans. Evolution leads to gradual changes in the anatomical and functional dimensions in species leading to the concept of rudimentary or a vestigial organ. The concept of natural selection forms the basis of evolution, which selectively eliminates the rudimentary structures. In the maxillofacial region, the third molar teeth are considered vestigial in nature, in addition to small tendinous muscles and muscles of the ear [1]. On the other hand, third molars' role cannot be underweighted as an important tool in forensic investigations. Considering the stage of calcification and the root formation of the third molars, the dental age of an individual can be predicted [2]. Moreover, healthy third molar teeth' pulp tissue is one of the most easily accessible sources for stem cells. Thus, third molars could also play a vital role in regenerative medicine [3]. Hence, agenesis of third molars could impact as it serves as a valuable tool in these aspects. It is well known that the third molars (M3s) are most commonly involved in various teeth-related aberrancies or anomalies.

Even though there are differences in facial growth, jaw size, and tooth size amongst different races and ethnic groups, the M3s remain the last teeth to erupt in the permanent dentition. Also, agenesis and impaction of M3s is not an unusual occurrence [4]. Agenesis of M3s is the most common developmental anomaly in permanent dentition. The prevalence of agenesis of M3 varies greatly from 0% in Tasmanian population to 49% in Hungarian population [5].

This increase in the incidence of agenesis of M3 has been attributed to the gradual degeneration of dentofacial development over the past 5000 years [6]. This change in the trend of gradual diminishment of M3 teeth is an important aspect of human evolutionary process. In the prehistoric era, M3 teeth were considered vital for the survival of humans. Studies have shown that the longer arch length of the jaw compared to the present times could accommodate the M3s easily, which could aid in mastication and provide nutrition for early humans [7-10]. Similarly, there has been a reducing trend in the width of the jaws as well as in the dimension of teeth [10]. As a result, M3s are not accommodated in the dental arches and they remain buried or fail to develop at all, leading to agenesis. Studies have not shown any significant link between sex and third molar agenesis prevalence [4,1-15].

The chronology of third molar formation, calcification, and eruption has shown differences among various ethnic groups [16]. Studies have also revealed that a single missing M3 tooth was most commonly encountered, followed by two, three, and four teeth [11,12,17-19]. Hence, we aimed to assess the prevalence of third molar agenesis among 12-18-years-old in a hospital-based population. The objective was to compare the distribution of third molar agenesis between males and females. The null hypothesis was no significant difference in the distribution of third molar agenesis between males and females.

Material and Methods

Study Design and Ethical Clearance

This retrospective study was performed on digital panoramic radiographs retrieved from the archives of Oral Radiology. Radiographs of patients who underwent panoramic radiographic examination from January 2016 to December 2018 were included in the study. Institutional ethics committee approved the conduct of the study (IEC 912/2018). The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) guidelines was used to report the study findings [20].

Data Collection

Good quality digital panoramic radiographs of patients between 12 to 18 years were included in the study. Radiographs showing the presence of any jaw pathology such as cysts/tumors or fractures were excluded from this study. Also, radiographs with ghost images, artefacts were excluded from the study. Panoramic radiographs were independently evaluated by two senior radiologists. The recruited radiographs were completely anonymized by a person who was not a part of this study. Following this, the radiographs were evaluated in a computer monitor under optimum viewing conditions. The examination of radiographs was performed in the same setting by both the examiners. The basic demographic data (age and sex) and the primary findings regarding the presence or absence of third molars (M3s) in the maxillary and mandibular arches were recorded systematically in a specially designed proforma.

Data Analysis

The data were entered in a Microsoft Excel spreadsheet and statistical tests were done using SPSS Statistics for Windows, version 20 (IBM Corp., Armonk, NY, USA). The gathered data was correlated with the sex, the quadrant of agenesis, and the total number of quadrants having agenesis of M3 tooth for each radiograph. A p-value of <0.05 was considered statistically significant. Categorical variables were compared using the Chi-square test.

Results

Overall, 2374 panoramic radiographs were accessed from the Radiological archives for the study period. Of these, 355 radiographs of patients with facial fractures, 3 patients with TMJ ankylosis, and 16 patients with mandibular pathology (benign tumors or cysts) were excluded from the study. Hence, 2000 panoramic radiographs were included in the study, of which 1004 were females (50.2%), and 996 were males (49.8%). A total of 1514 patients (75.7%) had M3s in all four quadrants, and the remaining 486 patients (24.3%) had agenesis of M3 tooth in at least one of the quadrants. Single tooth agenesis was observed in 219 (11%) patients, two teeth agenesis in 172 (8.6%) patients, three teeth agenesis in 39 (2%) patients, and four teeth agenesis in 56 (2.8%) patients (Table 1).

Table 1. Distribution of third molar agenesis.

Third Molar Agensis	N (%)
No Agensis	1514 (75.7)
Single	219 (11.0)
Two	172 (8.6)
Three	39 (2.0)
Four	56 (2.8)

The highest incidence of agenesis was observed in the right maxillary M3 (15.6%), followed by left maxillary M3 (13.2%), right mandibular M3 (9.4%), and left mandibular M3 (7%) (Table 2). Maxillary M3s showed a higher prevalence of agenesis (18.8%) than mandibular M3s (11.6%). Also, it was noted that the right side M3s had a prevalence of agenesis (20.4%) compared to the left side (16.4%).

Table 2. Distribution of third molar agenesis in each quadrant.

Tooth	N (%)
Right Maxillary M3	312 (15.6)
Left Maxillary M3	263 (13.2)

Right Mandibular M3	187 (9.4)
Left Mandibular M3	141 (7.0)

It was noted that a significantly higher proportion of males than females had right and left maxillary M3 agensis ($p=0.013$ and $p=0.005$, respectively). Similarly, males showed a significantly higher proportion of right mandibular M3 agensis than females ($p=0.022$). However, no significant difference was seen between the left mandibular M3 agensis and the sex. Concerning bilateral maxillary M3 agensis, males exhibited significantly higher proportion than females ($p=0.012$). In contrast, no such difference was seen between bilateral mandibular M3 and the sex ($p=0.16$). There was no significant difference noted in males and females ($p=0.399$) with the agensis of M3 in all quadrants (Table 3).

Table 3. Comparison of agensis of third molars between males and females.

Tooth	Agensis	Sex		p-value
		Male N (%)	Female N (%)	
Right Maxillary Third Molar	Absent	820 (82.3)	867 (86.4)	0.013
	Present	176 (17.7)	137 (13.6)	
Left Maxillary Third Molar	Absent	844 (84.7)	893 (88.9)	0.005
	Present	152 (15.3)	111 (11.1)	
Left Mandibular Third Molar	Absent	916 (92.0)	943 (93.9)	0.087
	Present	80 (8.0)	61 (6.1)	
Right Mandibular Third Molar	Absent	888 (89.2)	925 (92.1)	0.022
	Present	108 (10.8)	79 (7.9)	
Bilateral Maxillary Third Molar	Absent	879 (88.3)	920 (91.6)	0.012
	Present	117 (11.7)	84 (8.4)	
Bilateral Mandibular Third Molar	Absent	942 (94.6)	963 (95.9)	0.16
	Present	54 (5.4)	41 (4.1)	
All Quadrants Third Molar	Absent	965 (96.9)	979 (97.5)	0.399
	Present	31 (3.1)	25 (2.5)	

Discussion

Agensis or failure of development of a missing tooth is a condition where a tooth fails to develop during the period of growth and development. In permanent dentition, third molar teeth are the most common to exhibit agensis. The reason for agensis M3 is unclear, and it could probably represent evolutionary changes in the jaw size of humans. Even though there are racial and social variations, studies have shown that the third molar calcification starts from 7 to 10 years of age and is completed by 12 to 16 years of age [16,21-23]. Hence, in line with these studies, we included patients above 12 years of age in this study.

Third molar removal is one of the most commonly performed dentoalveolar surgery in young adults, and they bear a huge financial implication on the healthcare system. Due to various aberrancy in the eruption pattern and tooth position, numerous pathologies like cysts and tumors have been associated with impacted third molars. These pathologies are disconcerting for the patient and can prove to be debilitating on the long end. Hence, various clinicians advise that these third molars, which are now considered vestigial, should be prophylactically removed.

Knowledge about the prevalence rates of third molar agensis gives an approximate estimate about its relationship with the prevalence of impacted third molars in a particular ethnic group. The prevalence rate of third molar agensis has been reported to range from 10% to 41%. A most important factor for such variation

in prevalence rates is ethnic variation. African-Americans have reported having the lowest prevalence at 10.1%, and the Koreans have been reported to have the highest prevalence of M3 agenesis at 41% [22,24]. In a Malaysian study with a large sample size of 4228 individuals, a prevalence of 38.4% was reported in the Malaysian population [25]. In other Asian groups, like Turkish population, a prevalence rate of 23.3% was observed. In a systematic review and meta-analysis by Carter and Worthington, which evaluated 92 studies on M3 agenesis, a worldwide rate of M3 agenesis was reported to be 22.63% (95% CI = 20.64% to 24.76%) [26].

Similarly, studies on North Indian students in Punjab's city showed M3 agenesis in 24% and 26% in three different study groups [27,28]. However, studies done on South-Indian population have shown a wide variation in the prevalence rate. In a study on a relatively small sample size of 150 individuals, a prevalence rate of only 5.4% was reported [29]. On the contrary, another study on 50 individuals showed a prevalence rate of 56% [30]. A study involving a study population of 1005 showed a prevalence of mandibular M3 agenesis of 12%. However, this study was done to evaluate the status of mandibular M3 only. The present study has estimated the prevalence of M3 agenesis with the largest study sample size in South Indian population that revealed a prevalence rate of 24.3%, which is in accordance with the studies done in the rest of the world.

Perhaps the most controversial aspect regarding the study of M3 congenital agenesis has been its sex predilection. It has been hypothesized that due to a relatively smaller size of the jaw, the females tend to have a higher prevalence of M3 agenesis [31]. The majority of the studies conducted indeed suggest that, on average, the females are 14% more likely to have missing M3s [25]. However, the findings of the present study have shown contradictory findings. While the maxillary and mandibular M3 agenesis showed significantly higher prevalence in males. On the contrary, mandibular right M3 agenesis showed significantly higher prevalence in males, and the mandibular left M3 agenesis did not show any significant difference.

Numerous studies have suggested that the number of M3 agenesis in an individual followed a pattern in which a single missing molar was the most common finding, followed by two, four and three missing molars [25,28,32]. The meta-analysis done by Carter and Worthington gave a more accurate picture, which showed that individuals were more likely to have 1 or 2 M3 agenesis than to have 3 or 4 M3 agenesis [26]. Our study's findings showed a similar trend, where single M3 agenesis was the most prevalent condition, followed by two, four and three M3 agenesis. The occurrence of a higher prevalence of four missing M3s as compared to three missing M3s could be attributed to the fact that there is a higher possibility of symmetrical M3 agenesis in an individual.

The other parameters researched previously have been regarding the comparative analysis between the jaw sides and the arches for prevalence of M3 agenesis. Studies on the Bangladeshi population showed a significantly higher M3 agenesis on the right side for maxillary arch. However, there was no significant difference between the left and right sides of mandibular arch for M3 agenesis [25]. One study on South Indian population suggested a relatively higher prevalence of M3 agenesis on right side in mandibular arch, but no statistical significance could be derived [33]. In the present study, on a cumulative assessment, we found the right side had a significantly higher prevalence of M3 agenesis than the left side of the jaws. The data is more clear when it comes to comparative assessment of M3 agenesis between the maxillary and mandibular arches. The majority of the studies have shown a significantly higher prevalence of M3 agenesis in maxillary arch than the mandibular arch [25]. This was further substantiated by the meta-analysis done by Carter and Worthington. As per their observations, maxillary arch showed a higher rate of M3 agenesis (mean = 18.9%) as compared to mandibular arch (mean = 15.25%) (odds ratio = 1.36, 95% CI = 1.17 to 1.59) [26].

The present study's findings are in line with the trend observed worldwide and showed a higher prevalence of M3 agenesis in maxillary arch compared to the mandibular arch. Agensis of M3 teeth is not an uncommon finding; the prevalence of agensis estimated from the present study population further confirms it as one of the evolutionary changes in humans' jaws.

The limitations of the present study include time-bound recruitment of radiographs, which may represent a limited number. The retrospective nature of this study may also not represent the true agensis of the hospital-based population. Further, exclusion of radiographs of subjects with jaw pathologies and fractures adds to the loss of data from those subset of the population. Within the limitation of this study, it can be concluded that in the process of evolution, the incidence of third molar agensis is increasing. Different ethnic races have varied percentile of third molar agensis.

Conclusion

The present study exhibited a maximum number of single tooth agensis. It was also observed that maxillary third molar agensis is more than the mandibular third molar and the right side is more than the left side. Agensis of the third molar is more prevalent in males as compared to females. However, a larger number of subjects need to be evaluated to establish the appropriate number of agensis.

Authors' Contributions

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All authors declare that they contributed to critical review of intellectual content and approval of the final version to be published.

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None.

Conflict of Interest

The authors declare no conflicts of interest.

Data Availability

The data used to support the findings of this study can be made available upon request to the corresponding author.

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