ISSN 2515-8260 Volume 07, Issue 07, 2020

Prevalence And Patterns Of Third Molar Agenesis Among Three Major Ethnic Groups In Malaysia And Its Association With Agenesis Of Other Teeth

Dr. Ramesh Kumaresan[1], Dr. Navaneetha Cugati[2], Dr. Priyadarshini Karthikeyan[3], Dr. Neeraja Turagam[4], Dr Ravi Shankar Babu Y[5], Dr. Durga Prasad Mudrakola[6], Dr. Mandava Deepthi[7]

[1]Associate Professor, Faculty of Dentistry, AIMST University, Malaysia;
[2]Professor, Dept of Pedodontics and Preventive Dentistry,Coorg Institute of Dental Sciences, Karnataka,India;
[3]Lecturer, Department of Oral Medicine and Radiology,Faculty of Dentistry, AIMST University, Malaysia;
[4]Senior Lecturer, Faculty of Dentistry, AIMST University, Malaysia;
[5]Senior Lecturer, Faculty of Dentistry, AIMST University, Malaysia.
[6]Associate Professor, Department of Periodontology,AIMST University, Faculty of Dentistry, Malaysia;
[7]Associate Professor, Department of Conservative Dentistry &Endodontics,AIMST University, Faculty of Dentistry, Malaysia.

Email- rame1264@gmail.com[1]; neetucugati@rediffmail.com[2]; priyadrkarthi@gmail.com[3]; neer222@gmail.com[4];yelamanchi@gmail.com[5];docmdp@rediffmail.com[6];mandavamds@gmail.com[7]

ABSTRACT: Background: The third molar (M3) tooth is of clinical interest to different specialties in dentistry. Being the last tooth to develop in the human dentition it is also the most commonly malformed teeth. The agenesis of the third molars is linked to the evolution and growth of the human jaw and is also associated with other dental anomalies and has significance from evolution point of view.
Objective:The objective of this study was to establish the prevalence and distribution of M3 agenesis among the three major ethnicities of Malaysian population and to evaluate its association with hypodontia of other teeth.
Materials & Methods:Panoramic radiographs of 1514 Malaysian children were examined for the presence or absence of M3 and other class of teeth. The frequency of M3 agenesis was calculated by ethnic group, gender, tooth location along with its association with hypodontia of other teeth. Comparison between groups was done using the Chi-square test at a level of significance of 0.05

ISSN 2515-8260 Volume 07, Issue 07, 2020

***Results:**The prevalence of one or more M3 agenesis in Malaysian population was 20.1%. The prevalence of M3 agenesis was highest among the Malaysian Malays (22.6%) compared to the Chinese (21.3%) and Indians (17.2%). Agenesis of M3 showed an overall greater predilection for the maxillary arch (21%) than the mandibular arch (17.1%). Patients with M3 agenesis were more prone to have hypodontia of other teeth (15.36%) when compared to patients who have third molars (4.06%).*

***Conclusion:**Malaysian Malays and Chinese had a higher prevalence of M3 agenesis than Malaysian Indian. Hypodontia of other teeth was more prevalent in patient with M3 agenesis, hence, proving an inter-relationship between M3 agenesis and hypodontia among other class of teeth.*

***Keywords:**Dental agenesis; third molar agenesis; ethnic variations; hypodontia.*

1. INTRODUCTION

Dental agenesis or hypodontia is one of the most common morphologic anomalies of human dentition which is characterized by the developmental absence of one or more teeth.[1] Abnormalities of dental epithelium and failure of initiation of tooth development by underlying mesenchyme have been considered as the etiological causes of congenital absence of teeth. Various other causes of tooth agenesis include environmental factors such as radiation, chemotherapy trauma and infection, genetic polymorphisms, systemic diseases, and diet were suggested to affect tooth development with effects on the tooth size, shape, position, eruption and total absence.[2-6]

The third molars (M3s), being the highly polymorphic teeth, are documented with highest incidence of being congenitally absent among all populations and the incidence has been increasing in recent decades.[7] The third molar (M3) develops entirely after birth and is also the last tooth to erupt in all ethnic groups despite racial variations in the eruption sequence and thus not surprising that anomalies in normal M3 patterning frequently occurs.[2]

The literature relating to the prevalence and distribution of M3 agenesis is rich documenting the worldwide prevalence on people of different ethnic and geographic origins. (Table 1). The reported prevalence of one or more missing M3s varies from as low as 5% in a Libyan population[8] to as high as 46% in an Indian population[9] with many reporting values in the range of 14-28%[2,10-15] in different populations. (Figure 1).

The differences in prevalence of M3 agenesis could be contributed to the variations in samples, different methods of radiography and clinical examinations, demographic details,and ethnic backgrounds.[16,17] Evolutionary changes might as well contribute to the differences.[18] Thus, one hypothesis for why studies reach different conclusions about the prevalence of M3 agenesis is that this pathology developed independently in different populations and it may develop from different underlying causes in each population.[16]

The M3 agenesis has also been associated with various other dental structural and developmental anomalies. It was concluded that other teeth are more frequently missing when one or more M3 are congenitally absent. Few authors also suggest that M3 agenesis may be considered as a symptomatic expression of a field affecting lateral incisors and second premolars too. Hence, M3 agenesis should never be considered alone, but always in relation to hypodontia of other teeth.[19]

ISSN 2515-8260 Volume 07, Issue 07, 2020

Literature reveals three studies regarding M3 agenesis in Malaysian population with varying inclusion criteria and differing results[2,20,21]. Furthermore, these studies does not study the prevalence of M3 agenesis among the three ethnicity in Malaysian population and also the association of M3 agenesis with hypodontia of other teeth was not included in these studies. Hence,the purpose of this retrospective radiographic study was to establish the prevalence and distribution of M3 agenesis among the three major ethnicities of Malaysian population and to compare findings with other national and international research. Our objective also included the association of this M3 agenesis with hypodontia of other teeth.

2. MATERIALS AND METHODS

Study design

A retrospective cross-sectional study was carried out using panoramic radiographs which were taken in the course of diagnosis and treatment at the AIMST University Dental Centre, Malaysia. Ethical approval was granted by Institution Ethical Committee. [Reference: AUHAEC 77/ FOD/ 2012]

Study sample

The sample included 1514 Malaysian children of known chronological age and gender. The radiographs of healthy children were randomly selected from patients attending the University Dental Hospital between 2009 and 2019 whose ages ranged from 13 to 18 years at the time of visit. The sample included patients from all the three-ethnic group of Malaysian population. The inclusion criteria were the availability of a panoramic radiograph of adequate quality, and no history of any medical conditions, syndromes or surgical treatments that may affect the development of permanent teeth. Radiographs of poor quality affecting permanent tooth visualization, genetic or congenital anomalies, or history of orthodontic treatment and ambiguous radiographs of subjects with no proper record of date of birth or date the radiographs were taken were excluded from the study.

Radiographic evaluation

Panoramic radiographs that were available as X-ray films were viewed on a negatoscope and radiographs that were available in the digital format were reviewed on a computer monitor. Each radiograph was examined by two investigators independently. The radiographs were examined for the presence of all teeth, including third molars, in each quadrant. A tooth was considered as present if there was evidence of crypt formation with or without the calcification of the crown and vice versa. Accordingly, each tooth was marked as present or absent. Teeth absent due to extraction were cross-checked with dental records and considered as not missing. In cases of uncertainty, two authors examined the radiographs together to arrive at a consensus of the tooth most likely to be missing. Three months later, 150 randomly selected radiographs were evaluated by both investigators. Both intra-examiner and inter-examiner reproducibility for identification of presence or absence of tooth were 100%.

Statistical Analysis:

All the data including the subject's gender, ethnic group, date of birth and date radiographs taken were entered in an EXCEL file.Chronological age is calculated by subtracting the date of birth from the date of radiograph and was recorded.

Data were processed using the Statistical Package for Social Sciences, version 23.0. The frequency of M3 agenesis was calculated by ethnicity, gender, and tooth location. Comparison between groups was done using the Chi-square test at a level of significance of 0.05.

3. RESULTS

A total of 1514 radiographs fulfilling inclusion criteria, from 728 (48%) males and 786 (52%) females were reviewed. The samples included the three major ethnicity of Malaysians with 452 (30.0%) Malays, 521 (34.4%) Chinese and 541 (35.7%) Indian as shown in Table 2. In total, 306 (20.1%) radiographs showed congenital missing of one or more M3, as depicted in Table 3. There was no significant difference noted in the prevalence of one or more M3 agenesis among the gender, however in a situation with all the four missing M3, the frequency was significantly higher in females than in males. (2.7% and 1.9% respectively). The prevalence of M3 agenesis was highest among the Malaysian Malays (22.6%) compared to the Chinese (21.3%) and Indians (17.2%).

Agenesis of M3 showed an overall greater predilection for the maxillary arch (21%) than the mandibular arch (17.1%) as depicted in Table 4. Also, all the three ethnic groups showed a higher incidence of missing M3s in the maxillary than mandibular arch. The incidence of missing M3s was highest in the right maxillary region (11.2%) followed by the left maxillary (9.8%), left mandibular (8.9%) and right mandibular (8.2%) regions.

The distribution of symmetrical M3 agenesis in opposing quadrants as depicted in Table 5 reveals that females had a higher incidence of symmetrical M3 agenesis than males when comparing the right and left quadrants. Moreover, the Chinese and Malays had a higher incidence of symmetricalM3 agenesis when compared to Indians.

Further investigation on association of M3 agenesis with hypodontia of from other teeth revealed a significant association as depicted in Table 6. Patients with M3 agenesis were four times more prone to have hypodontia of other teeth (15.36%) when compared to patients who have third molars (4.06%). As shown in Table 7, it is also noted that hypodontia from mandibular second premolar (27.37%) are more frequently associated with M3 agenesis followed by maxillary second premolars (18.95%). Whereas the maxillary first premolars are commonly absent in patient who had third molars. Figure 2 and 3 depicts the frequent distribution of hypodontia from other classes of tooth in patients with M3 agenesis and M3 present.

4. DISCUSSION:

One of the most significant instances of recent human evolution is the increasing frequency of individuals with M3 agenesis which is the most common craniofacial anomaly recorded in humans.[22-26] Changes in diet patterns, the degree of use of the masticatory apparatus, and genetic inheritance have affected human facial growth, jaw size, and tooth size effecting in the occurrence of M3 agenesis and teeth hypoplasia.[2] Among the various factors affecting M3 agenesis geographic and ethnic factors have a significant mention in various literatures. The demographics of Malaysia is represented by multiple ethnic groups constituting mainly of Malays, Chinese and Indian ethnicity. Henceforward, the current study compared the prevalence and distribution of M3 agenesis among the three major ethnic groups of Malaysia.

The age of the patients included in this study ranged between 13-18 years. The lower limit of the age of patients is selected as 13 years as various authors quoted as having recommended making a diagnosis of M3 agenesis after the age of 13 years, because of possibility of delayed calcification.[2] The upper limit was selected as 18 years to avoid confusion in case of missing M3 due to exodontia which is very common after 18 years of age.

One fifth (20.1%) of the study population showed a tendency for one or more missing M3s. Though the incidence is within thebroad range reported in studies on various populations[27-36] (Figure 1), the M3 agenesis recorded in our study is less than the previous studies performed in the similar population in Malaysia (26.2% & 25.7%)[2,20] However, those studies were performed in the population constituting predominantly the southern part of Malaysia and our study involves Malaysian population in the northern region of the country. A similar difference in the pattern of M3 agenesis is also noticed in few studies conducted in the various demographic region of India.[9,15,24-26] This demands further investigation among the population in different demographic regions of the same country.

The prevalence of M3 agenesis among all the three ethnic groups; Malays (22.6%), Chinese (21.3%), Indians (17.2%), noted in our study is marginally lower than the previous studies done in similar population for Malays (25.4%, 30% & 25.7%)[2,20,21], Chinese (32%, 33%)[2,21] and Indians (21.4%)[2]. The reason for the same might be the difference in the demographic distribution of the study samples in all these studies and the difference in the sample size among the studies with the current study covering a higher sample size. Additionally, our sample predominantly represented the sub-urban and rural population in the northern part of Malaysia in contrast to the other studies which included the urban setting.[2]

Our results also revealed that the Malays had significantly more missing M3s (22.6%) than other ethnic groups in Malaysia with Indians (17.2%) having the least prevalence of M3 agenesis. With respect to the ethnic groups, previous studies documented that M3 agenesis is more prevalent in Malaysian Chinese when compared to Malaysian Malays and their diet pattern was proposed as one of the reasons as Chinese diet include more soft diet as they prefer using chopsticks to handle the food.[2] On contrary our study documented M3 agenesis to be more prevalent in Malay population when compared to Chinese population, hence, demanding to explore the factors other than diet as a reason for such high prevalence in Malay population. However, our study reflects that Indians have least prevalence of M3 agenesis when compared to other ethnicities in Malaysia which agrees with the previous similar study.[2]

In relation to the gender prevalence, most of the studies found a higher prevalence of M3 agenesis in girls than boys,[2,8-10,37-40] with the exception of two studies on a Czech and Jordan population that reported the contrary.[11,13] However, a substantial number of studies documented no significant difference between the genders in terms of M3 agenesis.[41-46] We noted a marginally higher prevalence of one or more M3 agenesis in females, though not significant. However, in patients with all four M3 agenesis there is a significant higher prevalence in females than males. The reason for a female predominance can be explained by

the fact that the size of head, face, width of the teeth, and dimensions of the dental arch are generally larger in males than those of females.[47] Furthermore, females demonstrate slowed linear growth of the maxillary and mandibular after 12 and 14 years of age, respectively, whereas in males they continue to significantly grow until age 16 years.[48] It is also reinforced by the fact that M3 crypt formation, begins late after birth, especially in females when compared to males.[2]
Our results showed that greatest agenesis tendency was generally displayed by the maxillary teeth particularly the maxillary right M3s. This result is in correlation with other studies.[49-51]The reason for such predilection shall be attributed to the skeletal maturation during adolescence. Both the maxilla and mandible initially grow at the same speed, but soon the growth of mandible exceeds that of the maxilla, and while the mandible continues to grow, the maxilla ceases to grow.[2] Hence, the mandible grows more than twice in length when compared to maxilla which allows more space to accommodate mandibular M3. Nevertheless, few studies concluded an increased prevalence of M3 agenesis in mandible.[10,11,31,38,52] Also, few populations did not show any significant difference in missing M3 between the arches.[53,54]
Further investigation on association of M3 agenesis with hypodontia of from other teeth revealed that patients with M3 agenesis were four times more prone to have hypodontia of other teeth (15.36%) when compared to patients who have third molars (4.06%). This result is in correlation with other studies as well.[17]Similarly, it is also noted that hypodontia from mandibular second premolar are more frequently associated with M3 agenesis followed by maxillary second premolars. This might be explained by the fact that second premolars are the last teeth to form and erupt in its class. This result shows a significant positive association between the M3 agenesis and other dental anomaly especially hypodontia from other class of teeth.
While our patients comprise the three major ethnic groups in Malaysia, the study was conducted in a sub-urban setting, and as such, might not be representative of the entire Malaysian population. Since we observed equally high prevalence of M3 agenesis among the Malays in comparison to the other two ethnic groups, further detailed studies on demographic factors, diet and age-related dental and skeletal maturation among the various ethnic groups are recommended. Also, since our study reveals a strong association between M3 agenesis and hypodontia of other class of teeth, further study relating the M3 agenesis and dental anomalies in Malaysian population would be more relevant.

5. CONCLUSION:
This study concluded that agenesis of M3 teeth in Malaysian population is in line with the internationally documented range, which conforms to the theory of the possible extinction of M3 in the future. This will have a significant implication for future age-estimation studies and forensic identification. Furthermore, the current study confirms the variations among M3 agenesis in relation to demographic setting, ethnic origin, gender, and location in the dental arch. Moreover, agenesis of maxillary and mandibular second premolars was found to be positively associated with missing M3. Further research studies are required to elucidate the different etiological factors responsible for this agenesis.

ISSN 2515-8260 Volume 07, Issue 07, 2020

Acknowledgment:
The authors would like to thank DrDeivanai Subramanian and Dr. K. Marimuthu, Department of Biotechnology, AIMST University, for their statistical assistance and Mr George Selvaraj, Dental Records Department, AIMST University for technical support.

Table 1: Summary of M3 agenesis studies

Year	**Country**	**Authors**	**Population**	**Sample size**	**Age Group**	**Prevalence**	**Predilection**		
							Sex	**Arch**	**Side**
1926	Japan	Hamano[27]	Adults	1300	-	18.4	-	-	-
1930	USA	Goblirsch[41]	American Whites	2112	-	9.0	NSD	-	-
1934	USA	Banks[28]	American Whites	461	15 - 22	19.7	-	-	-
1936	USA	Hellman[29]	Columbia University Students	433	-	25.4	Female	-	-
1946	Switzerland	Tanner[30]	-	534	13 - 17	17.6	-	-	-
1949	Greenland	Pedersen[55]	-	257	25 - 50	30.6	-	-	-
1954	USA	Nanda[49]	White Women	200	18-21	9.0	-	Maxilla	Right
1956	Sweden	Bjork et al.[32]	Boys (Lower Jaw)	243	12 - 20	13.3	-	-	-
1959	India	Nanda Chawla[37]	Indian Patients	1300	-	10.9 (Males)			
						14.5 (Females)	Female	-	-
1963	USA	Garn et al.[31]	Orthodontic Patients	476	≥14	16.4	-	Mandible	NSD
1964	USA	Keene[33]	US male naval recruits	195	17 - 25	25.0	-	-	-
1964	Hungary	Adler & Adler-	Orthodontic	591	18 - 21	27.6	-	-	-

ISSN 2515-8260 Volume 07, Issue 07, 2020

		Hradecky[34]	Patients						
1966	Germany	Sonnabend[35]	Orthodontic Patients	2000	15 - 30	22.4	-	-	-
1970	Great Britain	Lavelle et al.[42]	White British Population (Mandible)	400	18 - 25	15.3	NSD	-	-
1971	Finland	Haavikko[36]	-	298	14 - 18	20.8	-	-	-
1974	Burlington (America)	Thmopson et al.[43]	Burlington growth centre patients	521	16	22.3	NSD	NSD	-
1975	England (South)	Shinn[44]	Orthodontic Patients	2500	-	12.72	NSD	Maxilla (Males)	Right
1979	Canada	Shah & Boyd[56]	-	653	≥ 20	23.3	-	-	-
1981	Canada	Levesque et al.[45]	French-Canadian children and adults	4640	7 - 25	9.0	NSD	-	-
1985	Saudi Arabia	Haidar et al.[57]	Patients	1000	20 - 40	8.0	-	-	-
1990	Australia	Lynham[46]	Australian Defence Force recruits	662	-	22.7	NSD	-	-
1990	Mexico	Rosario and Gonzalez[58]	Children and Adolescents	500	7 - 18	32.4	-	-	-
1991	Germany	Bredy et al.[14]	Orthodontic Patients	2550	12 - 36	20.7	-	-	-
199	Jordan	Hattab et	Students	232	18 -	9.1	Male	Maxill	NS

ISSN 2515-8260 Volume 07, Issue 07, 2020

5		al.[13]			24			a	D
1996	Singapore	Mok and Ho[12]	Singapore Chinese	786	12 - 16	28.5	NSD	Maxilla	NSD
2001	New Zealand	Kruger et al.[59]	Adolescents	821	18	15.2	-	-	-
2004	Czech Republic	Rozkovcova et al.[11]	Patients	1000	12 - 21	22.5	Male	Mandible	Right
2005	India (Punjab)	Sandhu and Kaur[15]	Students	100	17.5 - 20	11.5	Female	-	-
2005	Israel	Goren et al.[52]	Male army recruits	226	18	5.83 (Males)	-	Mandible	-
2008	USA	Haris and Clark[10]	American whites and blacks	1700	12 - 18	27 (white)			
						11 (blacks)	Female	Mandible	-
2008	Chile	Garcia-Hernandez et al.[38]	Orthodontic Patients	400	14 - 20	24.75	Female	Mandible	Right
2009	Korea	Lee et al.[39]	Patients	1129	16 - 24	41.0	Female	-	-
2010	Turkey	Celikoglu et al.[22]	Orthodontic Patients	351	20 - 26	17.3	NSD	-	-
2012	Malaysia	Jacob John[2]	Dental patients	734	10 - 19	26.2	Female	Maxilla	Right
2012	India (South)	Ramamurthy et al.[24]	South Indian adults (Mandible)	1005	≥ 18	12.2 - 12.5	Female	-	NSD
2012	Libya	Byahatti and Ingafou[8]	Libyan Students	200	17 - 26	5.0	Female	Maxilla	-
2012	Romania	Golovcencu and Geletu[40]	Orthodontic Patients	250	11 - 25	28.0	Female	-	-
2012	Turkey	Celikoglue and Kamak[50]	Orthodontic Patients	1046	13 - 17	22.7	NSD	Maxilla	-

ISSN 2515-8260 Volume 07, Issue 07, 2020

2013	Japan	Endo et al.[60]	Orthodontic Patients	1291	-	32.3	-	-	-
2014	Malaysia	Mani et al.[20]	Malay Children	834	12 – 16	25.7	NSD	Maxilla	Right
2014	Malaysia	Alam et al.[21]	Orthodontic Patients	300	11 - 21	31.0	NSD	Maxilla	Right
2014	Pakistan	Bhutta et al.[19]	Orthodontic Patients	270	12 - 35	31.7			
2016	Bangladesh	Sujon et al.[61]	Patients	5923	10 - 50	38.4	Female	Maxilla	Right
2016	India	Ahire et al.[25]	Patients	100	18 - 25	14.5	-	-	-
2017	India	Nisha et al.[9]	Patients	300	18 - 25	46.7	Female	Maxilla	-
2017	Spain	Gómez de Diego et al.[62]	Orthodontic Patients	227	12 - 24	25.0	Female	-	-
2017	Nepal	Acharya et al.[51]	Orthodontic Patients	100	12 - 17	26.0		Maxilla	Right
2018	India Bhutan	PrashantPatil and Sarah Nazeer[26]	College students	55	18 - 25	23.6 (India) 35.3 (Bhutan)	Female	Maxilla	-
2019	Chile	Moreno et al.[53]	Patients	535	-	12.9	NSD	NSD	NSD
2019	Turkey	Ercal and Taysi[54]	Patients	594	11 - 24	28.7	NSD	NSD	NSD
2020	Peru	Miranda[63]	Patients	367	14 - 20	20.7	-	-	-
2020	Malaysia	Ramesh et al.	Dental patients	1514	13 - 18	20.1	Female	Maxilla	Right

NSD = No Significant Difference

ISSN 2515-8260 Volume 07, Issue 07, 2020

Table 2: Gender and ethnic distribution of samples

Ethnicity	Gender	n	N (%)	Total
Malay	M	211	452 (30.0%)	1514 (100%)
	F	241		
Chinese	M	238	521 (34.3%)	
	F	283		
Indian	M	279	541 (35.7%)	
	F	262		

Table 3: Gender and ethnic distribution of number of missing third molars (M3)[a]

	Total	**0**			**1**			**2**			**3**			**4**			**n[b]**		
	N	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p
Gender																			
	728	584 (80.2)	0.162	0.688	63 (8.7)	0.007	0.931	53 (7.3)	0.005	0.941	14 (1.9)	0.042	0.838	14 (1.9)	0.938*	0.333	144 (19.8)	0.162	0.688
	786	624 (79.4)			69 (8.8)			58 (7.4)			14 (1.8)			21 (2.7)			162 (20.7)		
Ethnicity																			
LY	452	350 (77.4)	5.003*	0.082	52 (11.5)	7.851*	0.02	31 (6.9)	0.383	0.826	7 (1.5)	0.34	0.844	12 (2.7)	2.640*	0.267	102 (22.6)	5.003*	0.082
HN	521	410 (78.7)			45 (8.6)			41 (7.9)			10 (1.9)			15 (2.9)			111 (21.3)		
N	54	448 (82			35 (6.			39 (7.			11 (2.			8 (1.			93 (17		

ISSN 2515-8260 Volume 07, Issue 07, 2020

D	1	.8)			5)			2)			0)			5)			.2)		
Total Sample n (%)	1514	1208 (79.9)			132 (8.7)			111 (7.3)			28 (1.8)			35 (2.3)			306 (20.1)		

M = Males; F = Females; MLY = Malay; CHN = Chinese; IND = Indian
a = Counts are by number of patients, not by number of teeth.
b = Patients with at least one missing M3.
p< 0.05.

Table 4: Location of the missing M3

	N	**Maxillary arch**						**Mandibular arch**					
		Right (18)			**Left (28)**			**Right (48)**			**Left (38)**		
		n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p
Gender													
M	728	84 (11.5)	0.135	0.713	73 (10)	0.55	0.815	48 (6.6)	4.755*	0.029	62 (8.5)	0.277	0.599
F	786	86 (10.9)			76 (9.7)			76 (9.7)			73 (9.3)		
Ethnicity													
MLY	452	65 (14.4)	6.883*	0.32	42 (9.3)	2.613*	0.271	35 (7.7)	2.184*	0.336	41 (9.1)	1.626*	0.444
CHN	521	55 (10.6)			60 (11.5)			50 (9.6)			52 (10.0)		
IND	541	50 (9.2)			47 (8.7)			39 (7.2)			42 (7.8)		
Total Sample	1514	170 (11.2)			149 (9.8)			124 (8.2)			135 (8.9)		

ISSN 2515-8260 Volume 07, Issue 07, 2020

M = Males; F = Females; MLY = Malay; CHN = Chinese; IND = Indian
p< 0.05.

Table 5: Distribution of symmetrical M3 agenesis

Tooth	18_28			38_48			18_48			28_38		
	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p	n (%)	χ^2	p
Gender												
M	54 (7.4)	0.171	0.679	38 (5.2)	2.072*	0.15	23 (3.2)	0.677*	0.411	21 (2.9)	0.767*	0.381
F	54 (6.9)			55 (7.0)			31 (3.9)			29 (3.7)		
Ethnicity												
MLY	35 (7.7)	1.359*	0.507	27 (6.0)	0.889*	0.641	19 (4.2)	0.637*	0.441	12 (2.7)	4.233*	0.12
CHN	40 (7.7)			36 (6.9)			20 (3.8)			24 (4.6)		
IND	33 (6.1)			30 (5.5)			15 (2.8)			14 (2.6)		
Total Sample	108 (7.1)			93 (6.1)			54 (3.6)			50 (3.3)		

M = Males; F = Females; MLY = Malay; CHN = Chinese; IND = Indian
p< 0.05.

Table 6: The association of M3 agenesis with hypodontia from other classes of teeth

	Total number of patients	**Patients with hypodontia of other classes of teeth**		
		n (%)	χ^2	p
Patients with M3 agenesis	306	47 (15.36)	4.853*	0.028
Patients with M3 present	1208	49 (4.06)		

p <0.05

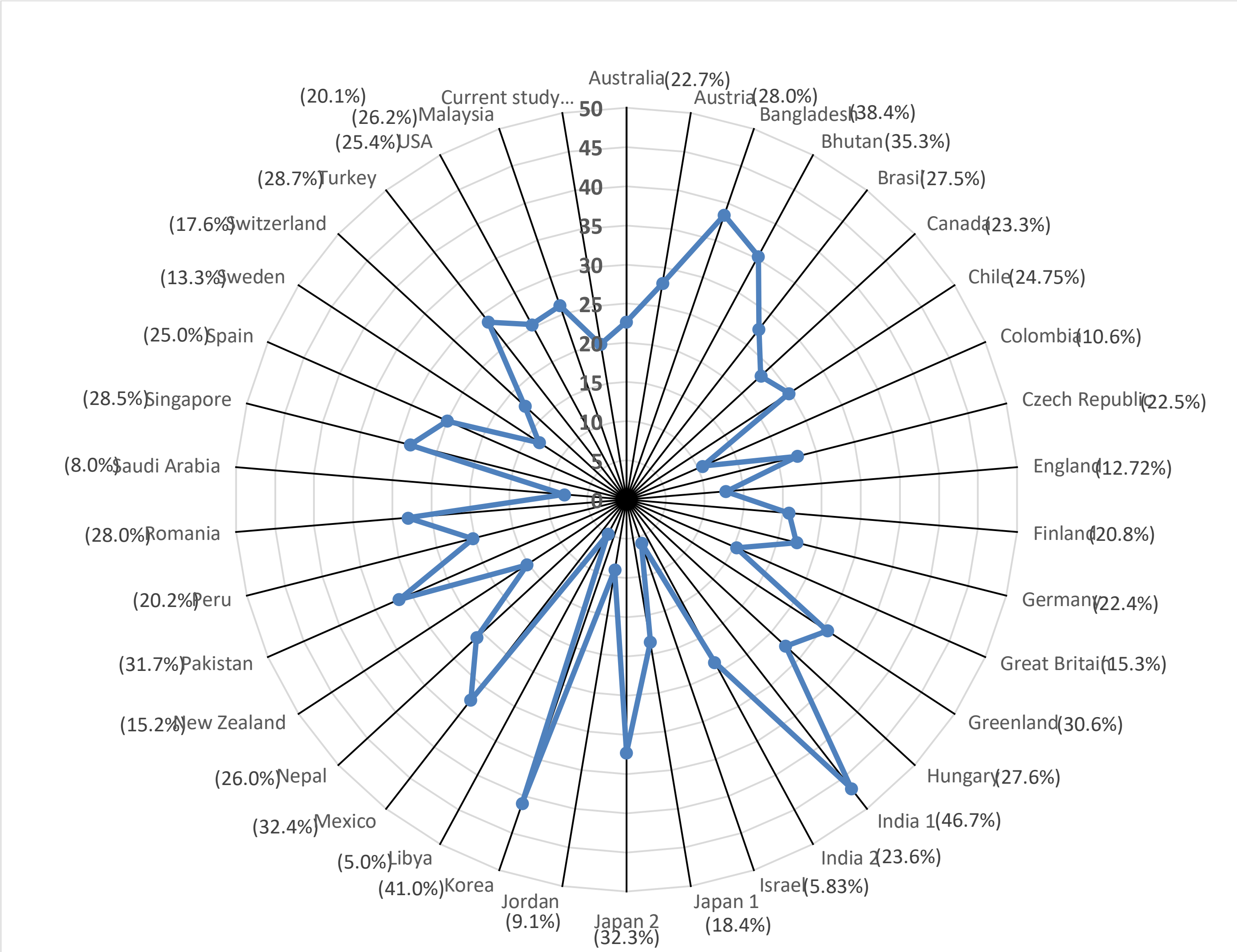
ISSN 2515-8260 Volume 07, Issue 07, 2020

Table 7: Distribution of hypodontia from other classes of teeth in M3 agenesis

Patients with M3 agenesis	**Total**	**Central Incisor**	**Lateral Incisor**	**Canine**	**First Premolar**	**Second Premolar**	**First Molar**	**Second Molar**
Hypodontia in Maxillary arch	**306**	2 (2.11)	8 (8.42)	2 (2.11)	11 (11.58)	18 (18.95)	2 (2.11)	0 (0)
Hypodontia in Mandibular arch		3 (3.16)	8 (8.42)	3 (3.16)	6 (6.32)	26 (27.37)	2 (2.11)	4 (4.21)
Patients with M3 present		**Central Incisor**	**Lateral Incisor**	**Canine**	**First Premolar**	**Second Premolar**	**First Molar**	**Second Molar**
Hypodontia in Maxillary arch	**1208**	1 (1.37)	9 (12.33)	11 (15.07)	16 (21.92)	10 (13.70)	0 (0)	2 (2.74)
Hypodontia in Mandibular arch		2 (2.74)	8 (10.96)	6 (8.22)	3 (4.11)	4 (5.48)	1 (1.37)	0 (0)

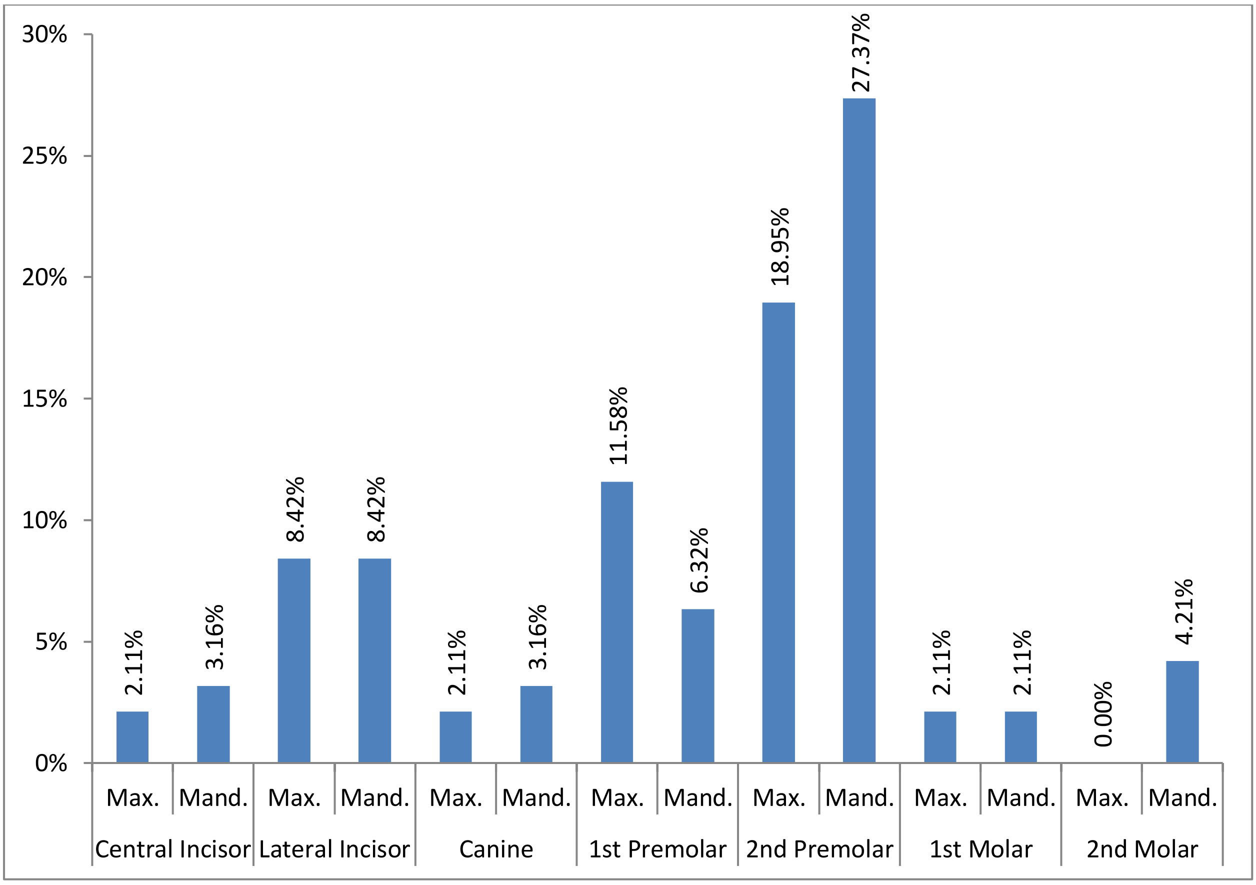
ISSN 2515-8260 Volume 07, Issue 07, 2020

Figure 1: Global Distributions of prevalence of M3 Agenesis



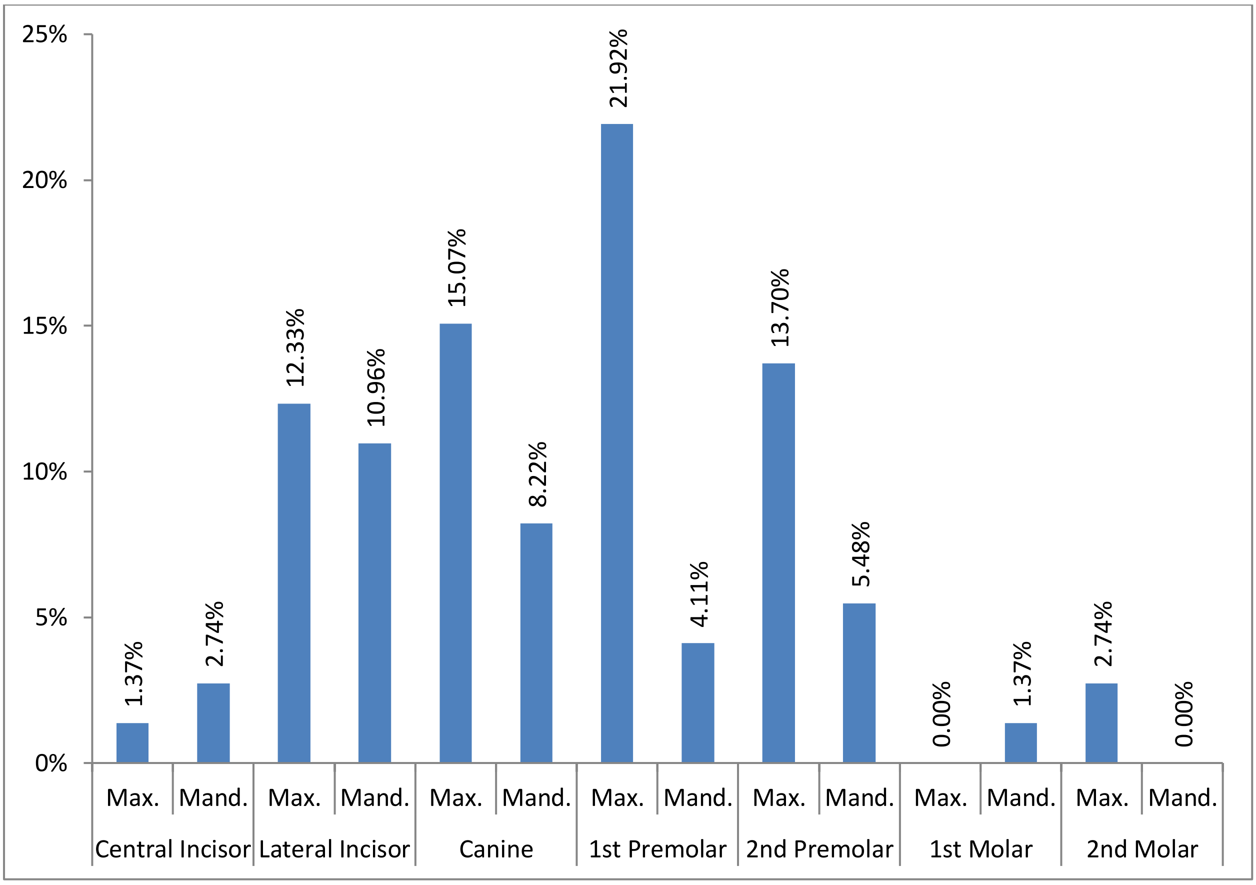
ISSN 2515-8260 Volume 07, Issue 07, 2020

Figure 2: Frequency distribution (%) of hypodontia from other classes of teeth in patients with M3 agenesis



Max. = Maxilla; Mand. = Mandible

Figure 3: Frequency distribution (%) of hypodontia from other classes of teeth in patients with M3 present



Max. = Maxilla; Mand. = Mandible

6. REFERENCES:

[1] Altan AB, Bicakci AA. Is third-molar agenesis related with the incidence of other missing teeth? Turkish J Orthod. 2014; 27: 143–147.

[2] John J, Nambiar P, Mani SA, Mohamed NH, Ahmad NF, Murad NA. Third molar agenesis among children and youth from three major races of Malaysians. Journal of Dental Sciences. 2012; 7: 211-217.

[3] Silvestri ARJ, Connolly RJ, Higgins MT. Selectively preventing development of third molars in rats using electrosurgical energy. J Am Dent Assoc 2004; 135: 1397-405.

[4] Nomura R, Shimizu T, Asada Y, Hirukawa S, Maeda T. Genetic mapping of the absence of third molars in EL mice to chromosome 3. J Dent Res 2003 ;82: 786-90.

[5] Bianch FJ, de Oliveira TF, Saito CB, Peres RC, Line SR. Association between polymorphism in the promoter region (G/C-915) of PAX9 gene and third molar agenesis. J Appl Oral Sci. 2007; 15:382-6.

[6] Karadzov OM, Sedlecki-Gvozdenovic SD, Demajo M, Milovanovic OK. The effects of X-ray irradiation of the head region of eight-day-old rats on the development of molar and incisor teeth. Strahlentherapie 1985; 161: 448-52.

[7] Acharya, Nisha&Poudel, Durga&Kafle, Dashrath. Pattern of Third Molar Agenesis among Patients with Different Skeletal Malocclusion. Orthodontic Journal of Nepal. 2018; 7: 23-26.

[8] Byahatti S, Ingafou MS. Prevalence of eruption status of third molars in Libyan students. Dent Res J (Isfahan). 2012;9(2):152-157.

[9] Singh N, Chaudhari S, Chaudhari R, Nagare S, Kulkarni A, Parkarwar P. A radiographic survey of agenesis of the third molar: A panoramic study. J Forensic Dent Sci. 2017;9(3):130-134.

[10] Harris EF, Clark LL. Hypodontia: an epidemiologic study of American black and white people. Am J OrthodDentofacialOrthop 2008;134:761-7.

[11] Rozkovcova´ E, Markova´ M, La´nik J, Zva´rova´ J. Agenesis of third molars in young Czech population. Prague Med Rep 2004;105:35-52.

[12] Mok YY, Ho KK. Congenitally absent third molars in 12 to 16 year old Singaporean Chinese patients: a retrospective radiographic study. Ann Acad Med Singapore 1996;25:828-30.

[13] Hattab FN, Rawashdeh MA, Fahmy MS. Impaction status of third molars in Jordanian students. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 1995;79:24-9.

[14] Bredy E, Erbring C, Hu¨benthal B. The incidence of hypodontia with the presence and absence of wisdom teeth. Dtsch Zahn MundKieferheilkdZentralbl 1991;79:357-63.

[15] Sandhu S, Kaur T. Radiographic evaluation of the status of third molars in the Asian-Indian students. J Oral MaxillofacSurg 2005;63:640-5.

[16] Goya HA, Tanaka S, Maeda T, Akimoto Y. An orthopantomographic study of hypodontia in permanent teeth of Japanese pediatric patients. J Oral Sci 2008;50:143-50.

[17] Amini F, Rakhshan V, Babaei P. Prevalence and pattern of hypodontia in the permanent dentition of 3374 Iranian orthodontic patients. Dent Res J 2012;9:245-50.

[18] Carter K, Worthington S. Morphologic and Demographic Predictors of Third Molar Agenesis: A Systematic Review and Meta-analysis. J Dent Res. 2015;94(7):886-894.

[19] Bhutta N, Sadozai SRK, Chatha MR. Correlation of third molar agenesis with hypodontia in an orthodontic population. Pakistan Oral & Dental Journal. 2014;34(4):656-9.

[20] Mani SA, Mohsin WS, John J. Prevalence and patterns of tooth agenesis among Malay children. Southeast Asian J Trop Med Public Health. 2014;45(2):490-498.

[21] Alam MK, Hamza MA, Khafiz MA, Rahman SA, Shaari R, Hassan A (2014) Multivariate Analysis of Factors Affecting Presence and/or Agenesis of Third Molar Tooth. PLoS ONE 9(6): e101157.

[22] Celikoglu M, Miloglu O, Kazanci F. Frequency of Agenesis, Impaction, Angulation, and Related Pathologic Changes of Third Molar Teeth in Orthodontic Patients. J Oral MaxillofacSurg 2010;68:990-5.

[23] Mostowska A, Kobielak A, Trzeciak WH. Molecular basis of nonsyndromic tooth agenesis: mutations of MSX1 and PAX9 reflect their role in patterning human dentition. Eur J Oral Sci 2003;111:365-70.

[24] Ramamurthy A, Pradha J, Jeeva S, Jeddy N, Sunitha J, Kumar S. Prevalence of mandibular third molar impaction and agenesis: A radiographic South Indian study.J Indian Acad Oral Med Radiol 2012;24:173-176

[25] Ahire BS, Bhoosreddy AR, Bhoosreddy S, Shinde MR, Pandharbale AA, Kunte VR. Radiographic assessment of agenesis, impaction, and pararadicularradiolucencies in relation with third molar in Nashik City of Maharashtra. J Dent Allied Sci 2016;5:3-6
[26] Patil P, Nazeer S. Prevalence of Third Molar Agenesis between the Individuals of Kerala and Bhutan: A Comparative Study. J Indian Acad Oral Med Radiol 2017;29:292-4
[27] Hamano M. Heredity in dentistry. Dent. Cosmos. 1935;77:1147–52.
[28] Banks HV. Incidence of third molar development. Angle Orthod 1934; 4: 223-33.
[29] Hellmann M. Our third molar teeth: their eruption, presence and absence. Dent Cosmos. 1936;78: 750–762.
[30] Tanner P. 1946. Die ZahnunterzahlimbleibendenGebissunterbesondererBerücksichtigung der Nichtanlage des Weisheitszähnes [dissertation]. [Zürich (Switzerland)]: Universität Zürich.
[31] Garn SM, Lewis AB, Vicinus JH. Third molar agenesis and reduction in the number of other teeth. J Dent Res 1962; 41: 717.
[32] Bjork A. Prediction of mandibular growth rotation. American Journal of Orthodontics. 1969;55: 585-599.
[33] Keene HJ. The relationship between third molar agenesis and the morphologic variability of the molar teeth. Angle Orthod.1965;35(4):289–298.
[34] Adler P, Adler-Hradecky C. Die Agenesie des Weisheitszähnes. Deutsche ZahnärztlicheZeitschrift. 1963;23:1361–1369.
[35] Sonnabend F. ZurUnterzahl der Zähneinsbesondere der drittenMolaren. Deutsche Zahn-Mund- und Kieferheilkunde.1966;46:34–43.
[36] Haavikko K. Hypodontia of permanent teeth: an orthopantomographic study. SuomenHammaslääkäriseuranToimituksia. 1971;67(4):219–225.
[37] Nanda RS, Chawla TN. 1959. Status of third molar teeth. J All India Dent Assoc. 31:19–29.
[38] Garcia-Hernandez F, Beltran V. Agenesia del tercer molar en unaetniaoriginariadel Norte de Chile: atacameños o licanantai. Int J Morphol.2008;26(3):583–590.
[39] Lee SH, Lee JY, Park HK, Kim YK. Development of third molars in Korean juveniles and adolescents. Forensic SciInt 2009;188:107-11.
[40] Golovcencu L, Geletu G. 2012. Correlation between third molar agenesis and particular dental conditions. Romanian J Oral Rehab. 4(3):5–9.
[41] Goblirsch AW. A study of third molar teeth. J Am Dent Assoc.1930;17(10):1849–1854.
[42] Lavelle CL, Moore WJ. The frequency of agenesis and polygenesis in the primate dentition. Am J PhysAnthropol. 1973;38(3):671–680.
[43] Thompson GW, Popovich F, Anderson DL. Third molar agenesis in the Burlington Growth Centre in Toronto. Community Dent Oral Epidemiol.1974;2(4):187–92.
[44] Shinn DL. Congenitally missing third molars in a British population. J Dent. 1976;4(1):42–44.
[45] Levesque GY, Demirijian A, Tanguay R. Sexual dimorphism in the development, emergence, and agenesis of the mandibular third molar. J Dent Res 1981;60:1735-41.
[46] Lynham A. Panoramic radiographic survey of hypodontia in Australian Defence Force recruits. Aust Dent J. 1990;35(1):19–22.

ISSN 2515-8260 Volume 07, Issue 07, 2020

[47] Hussein KW, Rajion ZA, Hassan R, Noor SN. Variations in tooth size and arch dimensions in Malay schoolchildren. AustOrthod J 2009;25:163-8.

[48] Chen L, Lin J, Xu T, Long X. The longitudinal sagittal growth changes of maxilla and mandible according to quantitative cervical vertebral maturation. J HuazhongUnivSciTechnolog Med Sci 2009;29:251-6.

[49] Nanda RS. Agenesis of the third molar in man. Am J Orthodontics 1954; 40: 698-706.

[50] Celikoglu M, Kazanci F, Miloglu O, Oztek O, Kamak H, Ceylan I. Frequency and characteristics of tooth agenesis among an orthodontic patient population. Med Oral Patol Oral Cir Bucal 2010; 15: e797-801.

[51] Acharya N, Paudel D, Kafle D. Pattern of Third Molar Agenesis among Patients with Different Skeletal Malocclusion. Orthodontic Journal of Nepal.2017;7(1):23-6.

[52] Goren S, Tsoizner R, Dinbar A, Levin L, Brezniak N. Prevalence of congenitally missing teeth in Israeli recruits. RefuatHapeh Vehashinayim.2005;22(2):49–53.

[53] Moreno, María Trinidad, Díaz, Alejandro, González, Andrea, Manríquez-Soto, Germán, & Toro-Ibacache, Viviana.. Is Third Molar Agenesis an Anomaly or Just a Sign of Variation? Prevalence and Manner of Presentation of this Condition in a Sample from the Metropolitan Region of Chile. International Journal of Morphology2019;37(4): 1382-86.

[54] Ercal P, Taysi A E. Third molar agenesis: Prevalence and Association with agenesis of other teeth in a Turkish population. Niger J ClinPract 2020;23:392-7

[55] Pedersen PO. The east Greenland Eskimo dentition: numerical variations and anatomy. Meddelelserom Grönland.1949;142(3):1:256.

[56] Shah RM, Boyd MA. The relationship between presence and absence of third molars hypodontia of other teeth. J Dent Res 1979;58: 544.

[57] Haidar Z, Shalhoub SY. The incidence of impacted wisdom teeth in a Saudi community. Int J Oral Maxillofac Surg. 1986;15(5):569–571.

[58] Llarenadel Rosario ME, Nuno Gonzalez MM. Stages of formation and calcification of the third molar (Radiographic study of 500 Mexican children and adolescents). Rev ADM 1990;47:112e8 [In Spanish, English abstract].

[59] Kruger E, Thomson WM, Konthasinghe P. Third molar outcomes from age 18 to 26: findings from a population-based New Zealand longitudinal study. Oral Surg Oral Med Oral Pathol Oral RadiolEndod 2001;92:150-5.

[60] Endo T, Ozoe R, Kubota M, Akiyama M, Shimooka S. A survey of hypodontia in Japanese orthodontic patients. Am J OrthodDentofacialOrthop 2006; 129: 29-35.Fukuta Y, Totsuka M, Takeda Y, Yamamoto

[61] Sujon MK, Alam MK, Rahman SA. Prevalence of Third Molar Agenesis: Associated Dental Anomalies in Non-Syndromic 5923 Patients. PLoS One. 2016;11(8):e0162070.

[62] Gómez de Diego R, Montero J, López-Valverde N, Ignacio de Nieves J, Prados-Frutos JC, López-Valverde A. Epidemiological survey on third molar agenesis and facial pattern among adolescents requiring orthodontic treatment. J ClinExp Dent. 2017;9(9):e1088-e1095.

[63] Miranda-Medina A. Agenesis of third molars and its association with other dental anomalies in a Peruvian population. J Oral Res 2020; 9(3):Article in press.