Original Article

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Dentistry Section

Eruption Time of Permanent Teeth among Kurds Aged 5-15 Years in Duhok Governorate- Kurdistan Region, Iraq

HOGER M NAJMAN[1], SAMIM A AL-DABBAGH[2], ZANA Q OMER[3]

ABSTRACT

Introduction: Tooth eruption time is affected by many factors. Eruption time of teeth and its sequence is important as part of dental treatment planning in Paediatric Dentistry, Orthodontics, as well as in Forensic Dentistry to estimate age of the child.

Aim: To estimate the eruption time of permanent teeth among school children aged 5-15 years in Duhok Governorate-Kurdistan Region, Iraq; in order to obtain a baseline data for treatment planning in clinical dentistry.

Materials and Methods: This was a cross sectional study comprising of 1418 healthy Kurdish children of both genders; 718 males and 700 females who were randomly selected by simple random method and examined from two kindergartens, four primary and four secondary schools in Duhok Governorate. The children were clinically assessed for tooth emerging through the oral mucosa. The mean and standard deviation of tooth eruption time for each tooth was estimated.

Results: Eruption time of permanent teeth tended to be earlier in girls than boys except for the teeth 11,14,15,21,24,25,31,34,35,36,41 and 44. The sequences of eruption of permanent teeth were 1-6-2-4-3-5-7 in the mandible, and 6-1-2-4-5-3-7 in maxilla in boys whereas it was 6-1-2-3-4-5-7 in the mandible, and 6-1-2-4-3-5-7 in the maxilla in girls.

Conclusion: The study provides information on eruption time for each tooth among Kurds children which can be useful in treatment planning in Paediatric and Orthodontic Dentistry.

Keywords: Paediatric dentistry, School children, Tooth eruption, Treatment planning

INTRODUCTION

Tooth eruption is defined as the movement of the tooth from its location of development in alveolar bone to the occlusal level in the oral cavity [1]. Tooth eruption is a unique developmental process in the organism. The factors or the mechanism of eruption has never been understood and the literature in this field is extremely scarce. The eruption of tooth is a complex process which involves five stages: pre eruptive, intraosseous, mucosal penetration, pre occlusal and post occlusal stages. Pre eruptive movements occur during crown formation and are so small that they can only be detected by vital staining tests. Active eruption occurs when root formation begins and therefore, it was believed that eruptive force comes from periodontal ligament development [1,2].

Although eruption mechanisms are still not fully understood and under debate, it was suggested that after the tooth has pierced oral mucosa after intraosseous stage, periodontium development induce eruption force [3]. Eruption time of the teeth and its sequences are important in dental treatment planning, mainly when patients require orthodontic treatment and also in Paediatric Dentistry. It can also help to find the age of adolescents and plays an essential role in Forensic Dentistry [1,2].

Shedding of primary teeth and the eruption of permanent teeth, is a constant age-related development by which the teeth ascend through the upper and lower jaws and the overlaying gingiva to enter into the oral cavity and occlude with the opposite teeth [4,5].

The permanent dentition usually emerges between the ages of 6-14 years that is called mixed dentition period, not including the third molars that usually emerge between ages of 17-21 years. Moreover, it can be of paramount importance in Forensic Medicine where age estimation is essential for criminal issues and also in persons who do not have proper birth certificates whether above or below 18 years of age because the teeth are the most stable structures in the human body [6,7].

Researches on eruption time of permanent teeth has not been done before in Duhok Governorate. Moreover, with time, several factors might affect the trend of permanent teeth eruption [4,5]. Hence, the aim of this study was to estimate the mean eruption time of permanent teeth as data-base for the future studies and researches among school children aged 5-15 years in Duhok Governorate-Kurdistan Region, Iraq.

MATERIALS AND METHODS

This was a cross sectional study on children aged between 5-15 years conducted from November 2017 to May 2018 in Duhok city, Kurdistan Region, Iraq.

Sample Selection

The kindergartens and schools were randomly selected by simple random sampling (https://www.random.org). Two kindergartens, four primary schools and four secondary schools were selected. The inclusion criteria were apparently healthy children aged 5 to 15 years and who got parent consent to participate in the study. The exclusion criteria were child suffering from a systemic disease or aged beyond the specified range. A sample size of 1418 children of both genders was selected for the study; estimated from equation N= (PQZ2D)/E2 where, N=sample size, P=estimated prevalence of tooth eruption time=0.50, Q=100-P, Z=95% confidence level=1.96, D=design effect=2, E=accepted standard error=0.04 [8]. All children from each selected kindergarten and schools were included in the study.

Ethical Considerations

Scientific approval was obtained from Hawler Medical University (no.317) and ethical permission to carry out the study was obtained from general directorate of education in Duhok city and the heads of schools. Moreover, a written consent was obtained from parents /caregiver of each participant.

Inter and Intra Examiners Calibration

The researcher and another specialised dentist examined a sample of (15) children aged 8 years for data collection of a primary school.

They had been tested in clinical assessment of an erupted and non erupted tooth for inter examiner calibration at same day of examination and after one week for intra examiner calibration by using two-digit FDI tooth numbering system.

Kappa test was done to determine the mean of inter and intra examiner consistence in recording tooth eruption, Kappa value was 1 for inter examiner and 0.79 for intra examiner calibration.

Dental Examination and Data Collection

The date of birth was verified from the school records and was used to compute the age of the child. Dental examination of the children was conducted in broad day light and supported by a head geared LED light with the help of plane disposable mouth mirrors, probes and tweezers after teeth were cleaned well by cotton for better visibility. Each permanent tooth was recorded using the two-digit system of the FDI [7]. The eruption of the teeth into the oral cavity was divided into four stages;

0=the tooth is not visible in the oral cavity;

1=at least one cusp is visible in the oral cavity;

2=the entire occlusal surface/mesio-distal width of the tooth is visible;

3=the tooth is in occlusion or at the occlusal level [6].

For this study, only 0 and 1 were analysed as non erupted and erupted respectively. Both score 2 and 3 were examined but not analysed because we only need to know the newly erupted teeth. Recording of extracted teeth due to caries was based on the World Health Organisation guidelines [9]. The Wisdom teeth were excluded.

The date of birth of students were recorded from the records given by the managers, then date of examination was recorded, and by SPSS program, the age was estimated at date of examination for each student by subtracting the date of birth from date of examination.

The mean age was calculated as mean age in years and months were divided by 12 to convert to years. For example, 10 years and 1 month will be 10+1/12=10.08 years.

STATISTICAL ANALYSIS

Data were analysed using the Statistical Package for Social Sciences (SPSS, version 22). Numerical variables were presented and summarised as means and standard deviations. Categorical variables were presented as proportions. Chi square test of association was used to compare proportions. A p-value of ≤0.05 was considered statistically significant.

RESULTS

The total sample of this study was 1418 students divided according to their gender into 718 males and 700 females. [Table/Fig-1] shows age and gender distribution of the study population. There was a significant difference in the age distribution of boys and girls (p=0.012).

The [Table/Fig-2] reveals the mean±SEM and the median age of teeth eruption for both males and females. Mostly all mandibular teeth (31,32,33,36,35,37,41,42,43,46, and 47) have erupted earlier than maxillary teeth (11,12,13,16,17,21,22,23,25,26, and 27), except maxillary teeth 14,15, and 24 which erupted earlier than mandibular teeth 45,44 and 34.

The first tooth erupted into oral cavity was mandibular right then left first molar proceeded by the mandibular left and right central incisors consequently.

[Table/Fig-3] shows that among males all mandibular teeth erupted earlier than maxillary teeth except for 15,14 and 24 which erupted earlier in maxillary arch. Also, the first tooth erupted in oral cavity was 36 proceeded by 31. Accordingly, the sequences of eruption in maxillary and mandibular teeth among male group will be as follow:

	Males		Females		Total		
Age (years)	No.	(%)	No.	(%)	No.	(%)	p-value
5	86	(12.0)	59	(8.4)	145	(10.2)	
6	82	(11.4)	49	(7.0)	131	(9.2)	
7	63	(8.8)	69	(9.9)	132	(9.3)	
8	100	(13.9)	89	(12.7)	189	(13.3)	
9	47	(6.5)	68	(9.7)	115	(8.1)	0.012
10	86	(12.0)	75	(10.7)	161	(11.4)	
11	60	(8.4)	71	(10.1)	131	(9.2)	
12	61	(8.5)	67	(9.6)	128	(9.0)	
13	67	(9.3)	75	(10.7)	142	(10.0)	
14*	66	(9.2)	78	(11.1)	144	(10.2)	
Total	718	(100.0)	700	(100.0)	1418	(100.0)	

[Table/Fig-1]: Age and gender distribution of study population (chi-square test).
*Age till 14 years and 364 days was considered and 15 years and above not included

Tooth	n*	Mean	SEM	Median
11 upper R* central incisor	12	7.72	0.30	7.92
12 upper R lateral incisor	29	8.34	0.20	8.25
13 upper R canine	52	11.26	0.17	11.17
14 upper R first premolar	24	9.73	0.27	9.25
15 upper R second premolar	12	10.63	0.47	10.21
16 upper R first molar	10	6.56	0.35	6.17
17 upper R second molar	20	12.43	0.29	12.42
21 upper L* central incisor	9	7.49	0.22	7.58
22 upper L lateral incisor	24	8.50	0.21	8.33
23 upper L canine	55	11.23	0.19	11.17
24 upper L first premolar	19	9.69	0.28	9.50
25 upper L second premolar	12	11.53	0.43	11.33
26 upper L first molar	13	6.62	0.25	6.33
27 upper L second molar	20	12.37	0.24	12.41
31 lower L central incisor	17	6.47	0.23	6.25
32 lower L lateral incisor	23	7.67	0.17	7.58
33 lower L canine	34	10.30	0.18	10.00
34 lower L first premolar	26	10.16	0.17	10.13
35 lower L second premolar	13	10.87	0.39	10.92
36 lower L first molar	9	6.27	0.23	6.08
37 lower L second molar	22	11.97	0.26	11.71
41 lower R central incisor	16	6.52	0.23	6.42
42 lower R lateral incisor	23	7.76	0.18	7.92
43 lower R canine	38	10.50	0.17	10.46
44 lower R first premolar	28	10.33	0.21	10.46
45 lower R second premolar	18	10.35	0.37	10.04
46 lower R first molar	11	6.20	0.27	5.83
47 lower R second molar	29	11.77	0.18	11.67

[Table/Fig-2]: Mean age of eruption, ±SEM and Median in years of maxillary and mandibular teeth among Kurds aged 5-15 years of both genders.
Note: N* =students' number; R* = right; L* = left

Maxillary arch sequence: first molar, central and lateral incisors, first and second premolars, followed by canine and second molar.

Mandibular arch sequence: central incisor, first molar, lateral incisor, first premolar, canine, second premolar, and second molar.

[Table/Fig-4] reveals that among females all mandibular teeth erupted earlier than maxillary teeth except 14,24 that erupted earlier in maxillary arch. Also, the first teeth erupted to oral cavity were 36,46 proceeded by 16,26 after calculating the mean of both right and left.

The sequences of eruption in maxillary and mandibular teeth among female group will be as follow:

Tooth	*n	Mean	SEM	Median
11 upper *R central incisor	3	7.47	0.44	7.92
12 upper R lateral incisor	9	8.63	0.38	8.75
13 upper R canine	29	11.52	0.22	11.25
14 upper R first premolar	17	9.51	0.31	8.83
15 upper R second premolar	5	9.60	0.36	9.33
16 upper R first molar	7	6.69	0.44	6.50
17 upper R second molar	9	12.54	0.37	12.67
21 upper *L central incisor	4	7.35	0.30	7.33
22 upper L lateral incisor	10	8.54	0.33	8.67
23 upper L canine	26	11.77	0.25	11.71
24 upper L first premolar	9	9.48	0.37	9.33
25 upper L second premolar	7	11.45	0.51	11.08
26 upper L first molar	10	6.64	0.26	6.50
27 upper L second molar	11	13.03	0.23	12.91
31 lower L central incisor	8	6.30	0.27	6.21
32 lower L lateral incisor	11	7.72	0.16	7.58
33 lower L canine	16	10.63	0.26	10.33
34 lower L first premolar	13	9.97	0.27	10.08
35 lower L second premolar	6	10.53	0.55	10.54
36 lower L first molar	5	6.10	0.13	6.08
37 lower L second molar	9	12.15	0.38	12.08
41 lower R central incisor	7	6.14	0.33	5.83
42 lower R lateral incisor	11	7.98	0.18	8.00
43 lower R canine	16	10.72	0.23	10.54
44 lower R first premolar	14	10.30	0.28	10.38
45 lower R second premolar	7	11.11	0.66	11.08
46 lower R first molar	6	6.36	0.39	5.96
47 lower R second molar	11	11.94	0.33	12.00

[Table/Fig-3]: Mean age of eruption ±SEM, and Median in years of maxillary and mandibular teeth among males Kurds aged 5-15 years.
N=students' number R = right; *L = left

Tooth	n	Mean	SE	Median
11 upper R central incisor	9	7.81	0.37	8.00
12 upper R lateral incisor	20	8.22	0.23	8.17
13 upper R canine	23	10.92	0.27	10.67
14 upper R first premolar	7	10.26	0.48	10.58
15 upper R second premolar	7	11.36	0.64	11.25
16 upper R first molar	3	6.25	0.64	5.83
17 upper R second molar	11	12.34	0.45	12.00
21 upper L central incisor	5	7.60	0.33	7.58
22 upper L lateral incisor	14	8.46	0.29	8.21
23 upper L canine	29	10.75	0.25	10.67
24 upper L first premolar	10	9.88	0.43	9.96
25 upper L second premolar	5	11.65	0.83	11.67
26 upper L first molar	3	6.53	0.73	6.25
27 upper L second molar	9	11.57	0.27	11.57
31 lower L central incisor	9	6.61	0.38	6.83
32 lower L lateral incisor	12	7.63	0.30	7.54
33 lower L canine	18	10.02	0.22	9.79
34 lower L first premolar	13	10.35	0.20	10.17
35 lower L second premolar	7	11.17	0.56	10.92
36 lower L first molar	4	6.48	0.52	6.50
37 lower L second molar	13	11.84	0.35	11.67
41 lower R central incisor	9	6.81	0.30	6.83
42 lower R lateral incisor	12	7.56	0.29	7.46
43 lower R canine	22	10.35	0.23	10.00
44 lower R first premolar	14	10.36	0.31	10.63
45 lower R second premolar	11	9.87	0.39	9.83
46 lower R first molar	5	6.00	0.38	5.50
47 lower R second molar	18	11.67	0.21	11.63

[Table/Fig-4]: Mean age of eruption ±SEM, and Median in years of maxillary and mandibular teeth among females Kurds aged 5-15 years.
Notes: pes of implan

Maxillary arch sequence: first molar, first incisor, lateral incisor, first premolar, canine, second premolar, and second molar.

Mandibular arch sequence: first molar, first incisor, lateral incisor, canine, first premolar, second premolar, and second molar.

Both [Table/Fig-3,4] illustrates that the mean eruption times for girls were lower compared to boys except for teeth (11,14,15,21, 24,25,31,34,35,36,41 and 44) which were found to erupt earlier in boys.

DISCUSSION

The study aimed for estimating the eruption time of permanent teeth among children aged 5-15 years to obtain baseline data for treatment planning in clinical dentistry in Kurdistan region, Iraq.

[Table/Fig-5] shows that among Kurd girls, the mean eruption time of teeth is slightly higher than other countries especially in incisors and second premolars except Iran which have higher mean than all [4,10-15].

[Table/Fig-6] shows that the mean eruption time among Kurds boys of maxillary teeth is significantly higher than other countries except first premolar but less than Indian. Also, among mandibular teeth mean age of central incisor and first molar is lower than other countries and other teeth are same or higher [4,10-15].

The mean age of eruption of first molars and central and lateral incisors of this study is similar to that conducted in Ramadi city (Iraq) except for the lower central and lateral incisors which erupted more than one year later in comparison to Duhok city [16].

Comparing the results with a study done in Ankara, Turkey the eruption time tended to be earlier in girls than boys in most of the groups except for the tooth 44 only. The sequences of eruption of permanent teeth were also different except in maxilla in boys which have same sequence in both studies [17].

The mean age of teeth eruption was nearly similar with the results among Jordanian children except for mandibular 2nd premolar which erupted about one year later [15].

In comparison to a study conducted in Iran which had nearly similar mean eruption age except for maxillary canine and both maxillary and mandibular first and second premolars in boys and maxillary premolars in girls which erupted more than 1.5 years later, while mandibular first and second molar of Iranian children erupted earlier than Kurd's mean age of tooth eruption [13].

On the other hand, the mean age of eruption of Kurds children agreed with the Australian children mean age in all teeth except in first and second premolars among girls which tended to erupt later by more than one year [12].

The results were also similar to that among Belgium children except for maxillary first and second premolars within boys which erupted later by about one year [11].

The finding shows that the permanent teeth erupted approximately at same times on right and left sides, the mandibular teeth tended to erupt earlier than their maxillary counterparts, and girls tended to be earlier compared with boys, reflecting previous studies in different populations. This data is very important in modifying the dental treatment plan in all age groups of Kurds children regarding Orthodontic and Paediatric Dentistry. In order to enrich the data base of Duhok city, it is recommended to do other studies on primary teeth eruption time and also the same study in other cities

Maxillary teeth	India (2001) [10]	Belgium (2003) [11]	Australia (2003) [12]	Iran (2004) [13]	Pakistan (2011) [14]	Jordan (2011) [15]	Uganda (2013) [4]	Kurds current study
Central incisor	7.5	6.9	7.2	7.6	7.5	7.11	6.2	7.7
Lateral incisor	8.0	7.9	8.2	8.8	8.4	8.0	7.2	8.3
Canine	10.4	11.0	11.2	12.1	10.7	11.0	9.3	10.8
First premolar	9.2	10.4	10.8	11.0	10.1	10.0	9.3	10.0
Second premolar	11.1	11.4	11.7	12.5	10.8	11.0	10.1	11.5
First molar	6.57	6.2	6.5	6.7	6.7	6.2	5.3	6.3
Second molar	11.95	12.0	12.3	12.5	12.0	12.3	10.7	11.9
Mandibular teeth	**India (2001) [10]**	**Belgium (2003) [11]**	**Australia (2003) [12]**	**Iran (2004) [13]**	**Pakistan (2011) [14]**	**Jordan (2011) [15]**	**Uganda (2013) [4]**	**Kurds current study**
Central Incisor	7.1	6.2	6.3	6.5	7.1	6.3	5.3	6.7
Lateral Incisor	7.5	7.1	7.4	7.9	7.9	7.3	6.0	7.5
Canine	8.9	9.7	10.1	10.3	10.0	9.8	8.0	10.1
First premolar	9.9	10.3	10.6	11.1	10.3	10.1	8.9	10.3
Second premolar	11.5	11.4	11.7	12.6	10.8	11.2	9.8	10.5
First molar	6.5	6.2	6.3	6.7	6.5	6.0	5.4	6.2
Second molar	11.6	11.6	11.8	12.4	11.4	11.6	9.4	11.7

[Table/Fig-5]: Comparison of mean eruption ages (years) of Kurds girls with those of other nationalities.

Maxillary teeth	India (2001) [10]	Belgium (2003) [11]	Australia (2003) [12]	Iran (2004) [13]	Pakistan (2011) [14]	Jordan (2011) [15]	Uganda (2013) [4]	Kurds current study
Central incisor	7.8	7.1	7.4	6.8	7.5	7.2	6.3	7.4
Lateral incisor	8.7	8.3	8.6	8.4	8.5	8.4	8.5	8.5
Canine	11.2	11.5	11.8	11.8	11.0	11.5	10.8	11.6
First premolar	10.2	10.7	11.3	12.0	10.1	10.4	9.6	9.4
Second premolar	11.5	11.6	12.1	12.0	10.1	11.3	9.5	10.5
First molar	6.9	6.3	6.7	6.8	6.7	6.3	6.4	6.6
Second molar	12.4	12.3	12.7	12.7	11.7	12.6	10.0	12.7
Mandibular teeth	**India (2001) [10]**	**Belgium (2003) [11]**	**Australia (2003) [12]**	**Iran (2004) [13]**	**Pakistan (2011) [14]**	**Jordan (2011) [15]**	**Uganda (2013) [4]**	**Kurds current study**
Central incisor	7.2	6.3	6.6	6.0	6.7	6.4	6.5	6.2
Lateral incisor	7.8	7.4	7.8	7.3	8.4	7.5	5.8	7.8
Canine	10.1	10.6	11.0	9.7	11.8	10.6	10.1	10.6
First premolar	11.1	10.7	11.2	10.1	12.2	10.5	10.0	10.1
Second premolar	12.5	11.7	12.1	10.9	12.8	11.7	10.8	10.8
First molar	6.8	6.3	6.6	5.6	6.8	6.2	6.0	6.2
Second molar	12.0	11.8	12.2	11.3	12.9	12.1	11.5	12.0

[Table/Fig-6]: Comparison of mean eruption ages (years) of Kurds boys with those of other nationalities.

for comparing and studying its relation with different factors that might have effect on the eruption time of teeth.

Limitation(s)

The main probable limitation was that this study was conducted on pupils, and not a community-based study. Pupils might be a selective sample not representing the whole community; whereas socio-economic variables might have effect on eruption time. This however, might have minimal effect on this study as attendance to primary and intermediate schools, from where the sample was selected, is obligatory in Kurdistan region so it is expected to represent the whole population.

Moreover, a follow-up study might give more accurate results in comparison to the type of cross-sectional design adopted in this study; as some teeth recorded as missing in this study may have actually been extracted for orthodontic reasons, or avulsed. Despite that, such possibilities would be too small to have a significant effect on the results especially with such a large sample size.

CONCLUSION(S)

The data presented in this paper provide first data base for all permanent teeth (except wisdom tooth) eruption time derived from a random sample of Kurd children. This will be essential for dental treatment planning in Preventive, Paediatric and Orthodontic Dentistry among Kurds children.

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PARTICULARS OF CONTRIBUTORS:
1. Assistant Lecturer, Department of Paedodontic Orthodontic Preventive Dentistry, University of Duhok College of Dentistry, Duhok, Kurdistan Region, Iraq.
2. Professor, Department of Family and Community Medicine, University of Duhok College of Medicine, Duhok, Kurdistan Region, Iraq.
3. Assistant Professor, Department of Paedodontic Orthodontic Preventive Dentistry, Hawler Medical University College of Dentistry, Hawler, Kurdistan Region, Iraq.

NAME, ADDRESS, E-MAIL ID OF THE CORRESPONDING AUTHOR:
Samim A Al-Dabbagh,
Nakhoshkhana Rd-10, Duhok, Kurdistan Region, Iraq.
E-mail: samimaldabbagh@yahoo.com

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- Financial or Other Competing Interests: No
- Was Ethics Committee Approval obtained for this study? Yes
- Was informed consent obtained from the subjects involved in the study? Yes
- For any images presented appropriate consent has been obtained from the subjects. Yes

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