

Age Estimation Based on the Pattern of Eruption of Permanent Teeth

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Abstract

Age estimation is one of the prime factors employed to establish identity. It is possible to arrive at a close estimation of age in children by studying the eruption pattern of the deciduous and permanent teeth. Subjects from different ethnic and socioeconomic groups present different stages of maturation, with remarkable genetic variations in the order of appearance of tooth. Hence there is a need to study the chronology and sequence of tooth eruption for the different populations [2]. In the present study, students from three different schools, belonging to different socioeconomic status were examined to present a new data on the timing and sequence of eruption permanent tooth. A total of 2925 students were selected for the study after ascertaining their exact age from the records. The mean age of eruption of permanent maxillary teeth is as follows: First molar (6.9 ± 0.7 years), Central incisor (7.8 ± 0.8 years), Lateral incisor (8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and Second molar (12 ± 0.8 years). The mean age of eruption of permanent mandibular teeth is as follows: First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8 ± 0.8 years), First premolar (11.1 ± 0.5 years), Second premolar (11.8 ± 0.8 years) and Second molar (11.9 ± 0.7 years). The mandibular teeth tended to erupt earlier than the corresponding maxillary teeth in both sexes except the premolars.

Keywords: Age; Children; Eruption; Mandibular; Maxillary; Permanent Teeth.

Introduction

Age estimation is one of the prime factors employed to establish identity. The needs of determination of age vary from intrauterine life to old age for different purposes. After birth and during those years when a child is developing, it is possible to arrive at a close estimation of age by studying the pattern of eruption of permanent and deciduous teeth [1]. Subjects from different ethnic and socioeconomic groups present different stages of maturation, with remarkable genetic variations in the order of appearance of the ossification centre and tooth formation (Carvalho et

al., 1990), requiring the establishment of patterns of chronology and sequence of tooth eruption for the different populations [2].

In literature there are a great number of investigations with regard to the eruption of teeth from various countries and among different races. Tables on eruption of the permanent teeth were published as early as 1837, when Saunders counted the individual tooth present in 1,046 children of 9 to 13 years. Twenty years later, Cartwright counted the teeth in 3,074 children throughout the school-age range, and published a table which has served as a model for scores of additional investigations during the 19th century. A study on British children done by E.M.B. Clements, E. Davies Thomas and Kathleen G. Pickett in 1947 included 1427 boys and 1365 girls attending elementary schools [3]. Albert A. Dahlberg and Renée M. Menegaz-Bock conducted a study on Pima Indian children (470 boys and 487 girls) ranging in age from 3 to 14 years and 11 months [4]. Here the observations are made on the basis of dental casts collected over a period starting in 1946 and continuing through 1957. Timing and sequence of eruption of permanent teeth in a longitudinal sample

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of children from Oregon was studied by Bhim Sen Savara and John C. Steen [5]. J Diamanti and G C Townsend studied the pattern of permanent tooth emergence in Australian children [6]. A randomly selected sample of 8676 children comprising 4476 boys and 4200 girls aged four to 16 years provided data for the study. These children represented approximately one-fifth of the total attendees at South Australian Dental Service (SADS) clinics during 1988.

A study conducted in the Aegean city of Izmir, Turkey comprises data from 1046 male and 1055 female patients (total 2101), aged 3.98 to 24.91 years (J.S. Wedl, V. Schoder, F.A.S. Blake, R. Schmelzle, R.E. Friedrich) [7]. They were examined in 2002 and the examination occurred within the framework of a dental check-up performed at two schools and one pre-school unit. Wisdom teeth were excluded. .

One of the earliest acceptable studies of eruption of permanent teeth of Indian children, is that of Shourie (1946) [8]. He prepared a table from investigations carried out in school children in the age group of 6 to 21 years drawn from the rice eating area of Madras (South India) and the wheat eating area of Lahore (now in Pakistan). S. Kaul, Sushama Saini and Bindu Saxena (1975) [9] studied the gingival emergence of permanent teeth except the third molar among 564 boys and 573 girls aged 6 to 14 years in Chandigarh. The subjects were classified into high, middle and low socio-economic groups. Amrit Tewari and Harpinder Singh Chawla (1978) [10] studied 1510 school children (953 males and 557 females) ranging from 6 to 16 years in the city of Chandigarh.

A community based study on the time of eruption of permanent 2nd and 3rd molar teeth to establish the age of an individual was undertaken on 1100 subjects (550 males and 550 females) residing in Delhi, in the age group of 10-21 yrs by Upendar Kishore, S K Verma and G K Sharma [11].

Studies conducted in South Indian children appear to be very meagre. Rakhi Gupta, Sivapatha sundharam B and Einstein A [12] conducted a study by recent time over 10,156 students (5104 boys and 5052 girls) in the age group of 6 to 9 years, from primary schools in various parts of Chennai. Another recent study done in Chennai [13] on permanent tooth eruption included 963 children (494 males and 469 females) in the age group of 4 to 14.5 years. A study conducted by Dr K Thankappan [14] on the eruption of permanent teeth (1980-1981) in Thiruvananthapuram, Kerala included a total of 2822 subjects (1426 males 1396 females) in the age group

of 4 to 21 years.

Given the changing composition of the community due to urbanisation and industrialisation over the past three decades, the improvements in oral health, and the reported secular trends that have occurred in physical growth and development, it is appropriate that new standards for permanent tooth emergence in boys and girls are provided. Therefore, the aim of this study is to present new data on the timing and sequence of permanent tooth emergence in a large sample of children from rural and urban areas of Thiruvananthapuram and to compare these findings with the results of earlier studies.

Materials and Methods

A cross sectional study was done among the students of three different schools from rural, semiurban and urban areas of Thiruvananthapuram during the time period April 2008-September 2009. Two thousand nine hundred students (males and females) were included in the study. Only those with the documentary proof of their date of birth were included in the study. The study was conducted with the approval letter from the Institutional Ethical Committee, Governmental Medical College, Thiruvananthapuram and the Principals of the schools where survey was done. Students who did not have the documentary proof of date of birth and those who were not willing to participate were excluded from the study. For statistical purposes, only completed year was taken into consideration. Random sampling was done by selecting the alternate students from the attendance register. The dental examination was made in the adequate light with the aid of a mouth mirror and a probe. The details of eruption were observed and charted according to the Modified System of Federation Dentaire Internationale (Modified F.D.I).

Data analysis was done with the help of Excel 2007 and SPSS 16 statistical software. The age distribution of the samples was found. The percentage of different teeth erupted at different ages was analysed separately for boys and girls to determine the mean age of eruption of individual tooth.

Results

The distribution of samples according to sex is shown in the Figure 1. Out of 2925 students, 1568

(54%) were males and 1357 (46%) were females. The distribution of students according to age and sex is shown in Figure 2.

Boys and girls were almost equally distributed in each age group except in age group seven and eight where boys are more (70%) than girls (30%).

In boys the upper central incisors erupted at 7.8 ± 0.7 years and the lower central incisors at 7.6 ± 0.7 years. In girls the upper central incisors erupted at 7.7 ± 0.8 years and the lower central incisors at 7.3 ± 0.8 years (Table 1). In boys the upper lateral incisors erupted at 8.7 ± 0.8 years and the lower lateral incisors at 8.0 ± 0.6 years. In girls the upper lateral incisors erupted at 9.0 ± 0.8 years and the lower lateral incisors at 7.8 ± 0.7 years (Table 2). In boys the upper canines erupted at 11.8 ± 1.0 years and the lower canines at 10.9 ± 0.8 years. In girls the upper canines erupted at 11.5 ± 0.9 years and the lower canines at 10.7 ± 0.8 years (Table 3). In boys the upper first premolars erupted at 10.7 ± 1.0 years and the lower first premolars at 11.1 ± 0.5 years. In girls the upper first premolars erupted at 10.6 ± 0.9 years and the lower first premolars at 11.1 ± 0.5 years (Table 4). In boys the upper second premolars erupted at 11.6 ± 0.9 years and the lower second premolars at 11.9 ± 0.8 years. In girls the upper second premolars

erupted at 11.4 ± 0.8 years and the lower second premolars at 1.6 ± 0.8 years (Table 5). In boys the upper first molars erupted at 7.0 ± 0.6 years and the lower first molars at 6.3 ± 0.7 years. In girls the upper first molars erupted at 6.7 ± 0.7 years and the lower first molars at 6.3 ± 0.8 years (Table 6). In boys the upper second molars erupted at 12.1 ± 0.8 years and the lower second molars at 12.0 ± 0.7 years. In girls the upper second molars erupted at 11.8 ± 0.9 years and the lower second molars at 11.8 ± 0.7 years (Table 7).

The order and time of eruption of permanent teeth in the upper jaw is as follows – First molar (6.9 ± 0.7 years), Central incisor (7.8 ± 0.8 years), Lateral incisor (8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and then the Second molar (12 ± 0.8 years). The order and time of eruption of permanent teeth in the lower jaw is as follows – First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8 ± 0.8 years), First premolar (11.1 ± 0.5 years), Second premolar (11.8 ± 0.8 years), and then the Second molar (11.9 ± 0.7 years).

All teeth erupted earlier in females except upper lateral incisors and lower first premolars. The upper

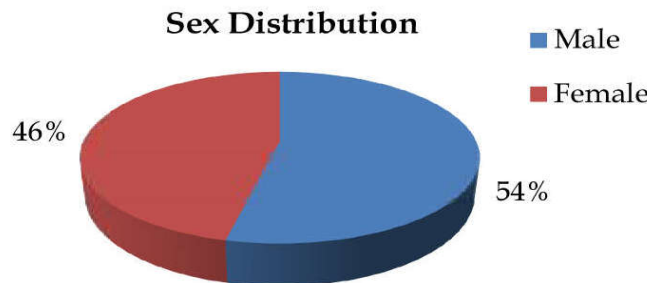


Fig. 1:

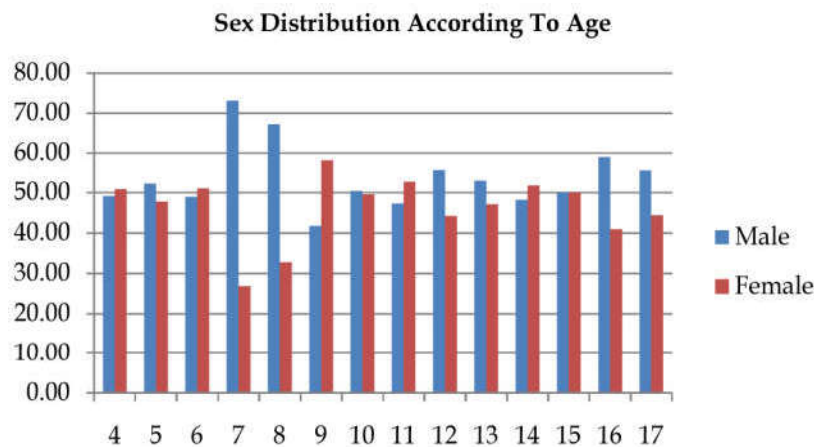


Fig. 2:

Table 1: Mean age of eruption of central incisors in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
11	7.8	0.7	7.7	0.7	7.8	0.7
21	7.8	0.7	7.7	0.8	7.7	0.8
Lower jaw						
31	7.6	0.8	7.3	0.9	7.5	0.9
41	7.6	0.5	7.2	0.6	7.4	0.5

Table 2: Mean age of eruption of lateral incisors in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
12	8.7	0.7	9	0.7	9	0.5
22	8.6	0.8	8.8	0.8	8.7	0.8
Lower jaw						
32	8	0.6	7.8	0.7	7.9	0.7
42	8	0.6	7.8	0.7	7.9	0.6

Table 3: Mean age of eruption of canines in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
13	11.8	0.8	11.5	0.9	11.6	0.8
23	11.6	1.1	11.4	0.9	11.5	1
Lower jaw						
33	10.9	0.7	10.7	0.8	10.8	0.8
43	10.8	0.9	10.7	0.8	10.8	0.8

Table 4: Mean age of eruption of first premolars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
14	10.7	0.9	10.6	0.9	10.7	0.9
24	10.6	1.1	10.6	0.9	10.6	1
Lower jaw						
34	11.1	0.5	11.1	0.5	11.1	0.5
44	11.1	0.5	11.1	0.5	11.1	0.5

Table 5: Mean age of eruption of second premolars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
15	11.6	1.1	11.4	0.9	11.5	1
25	11.6	0.6	11.4	0.7	11.5	0.7
Lower jaw						
35	11.8	0.8	11.6	0.8	11.7	0.8
45	11.9	0.7	11.6	0.7	11.7	0.7

Table 6: Mean age of eruption of first molars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
16	7	0.6	6.7	0.7	6.9	0.7
26	7	0.6	6.7	0.7	6.9	0.6
Lower jaw						
36	6.3	0.4	6.3	0.5	6.3	0.5
46	6.3	0.9	6.3	1	6.3	0.9

Table 7: Mean age of eruption of second molars in years with S.D

Teeth	Male		Female		Combined	
	Mean	Std. Deviation	Mean	Std. Deviation	Mean	Std. Deviation
Upper jaw						
17	12	1.1	11.7	1.1	11.8	1.1
27	12.2	0.5	11.9	0.6	12	0.6
Lower jaw						
37	11.9	0.7	11.7	0.7	11.8	0.7
47	12	0.7	11.8	0.7	11.9	0.7

Table 8: Mean time of eruption of permanent teeth – sex wise

Teeth	Mean age of eruption in years	
	Boys	Girls
Upper jaw		
First Molar	7.0 ± 0.6	6.7 ± 0.7
Central Incisor	7.8 ± 0.7	7.7 ± 0.8
Lateral Incisor	8.7 ± 0.8	9.0 ± 0.8
First Premolar	10.7 ± 1.0	10.6 ± 0.9
Second Premolar	11.6 ± 0.9	11.4 ± 0.8
Canine	11.8 ± 1.0	11.5 ± 0.9
Second Molar	12.1 ± 0.8	11.8 ± 0.9
Lower jaw		
First Molar	6.3 ± 0.7	6.3 ± 0.8
Central Incisor	7.6 ± 0.7	7.3 ± 0.7
Lateral Incisor	8.0 ± 0.6	7.8 ± 0.7
Canine	10.9 ± 0.8	10.7 ± 0.8
First Premolar	11.1 ± 0.5	11.1 ± 0.5
Second Premolar	11.9 ± 0.8	11.6 ± 0.8
Second Molar	12.0 ± 0.7	11.8 ± 0.7

lateral incisors erupted earlier in boys on an average of 3.6 months whereas the lower first premolars erupted at the same time in boys and girls (Table 8).

Discussion

The eruption of permanent teeth in human beings serves as a reliable age indicator as it has a sequential relation with age. But there are limitations on account of the influencing factors such as environment, heredity, nutritional and socioeconomic status. The aim of this study was to present new data on the timing and sequence of permanent tooth emergence in a large sample of children in Thiruvananthapuram and to compare these findings with the results of earlier studies. About 2925 students from different socioeconomic strata were taken as study samples and the findings were analysed statistically.

In the present study the differences in the mean time of eruption for homologous teeth in an arch (left and right) were either small (maximum of one month) or nonexistent. This is in agreement with most of the studies done in past years [3,5,7,9,10,14].

The present study also reveals that in either sex, the permanent teeth erupt first in the lower jaw except the premolars. Both the premolars emerged 3 to 5 months earlier in the upper jaw. It is in agreement with the results of most of the authors [3,4,6,7,10,14]. The maximum difference was noted for canines in both gender (9.6 months) and first molars in males (8.4months), and the minimum difference for second molars in both gender (1.2 months).

The sequence of eruption of permanent teeth in the upper jaw differs from that in the lower jaw, in the present study. The order of eruption in the upper jaw is as follows – first molar, central incisor, lateral incisor, first premolar, second premolar, canine and second molar. The order of eruption in the lower jaw is as follows – first molar, central incisor, lateral incisor, canine, first premolar, second premolar and second molar. However the order of eruption noted by Thankappan K [14] was different in the way that canine erupted after the eruption of first premolar but before the eruption of second premolar. The difference noted in the present study may be due to the early eruption of canine in the lower jaw on an average by 9.6 months when compared with the upper canine. E.M.B. Clements, E. Davies Thomas and

Kathleen G. Pickett [3] in their study on British Children noted a different pattern in the order of eruption. According to this study [3] the sequence of eruption in the upper jaw was – first molar, central incisor, lateral incisor, first premolar, canine, second premolar and second molar. In the lower jaw the sequence of eruption was – central incisor, first molar, lateral incisor, canine, first premolar, second molar and second premolar. J Diamanti and G C Townsend [6] studied the pattern of permanent tooth emergence in Australian children. In the upper jaw, the following sequence was noted: first molar, followed by central incisor, lateral incisor, first premolar, canine and second premolar, then second molar. In the lower jaw the order was: first molar and central incisor, followed by lateral incisor, then canine and first premolar, followed by second premolar and second molar. The order of eruption among most of the studies done in other countries also differ from the present study. This may be due to the influence of the racial characteristics in permanent tooth emergence.

In the present study all permanent teeth erupted earlier in girls except the upper lateral incisors and the lower first molars. However the maximum difference in the mean age of eruption between boys and girls was found to be 3.6 months. The upper lateral incisors erupted on an average 2.4 months earlier in boys when compared with girls. The first molars of the lower jaw erupted almost at the same time in boys and girls. The female preponderance of eruption pattern is in agreement with most of the earlier studies mentioned [5-7,10,12,14-21].

The time of eruption of permanent teeth among the samples taken from the same place of study in 1981 (Thankappan K) [14] is almost similar to the present study. However it is slightly delayed when compared with samples taken from Britain [3], Australia [6], Izmir [7] and Chandigarh [9].

Conclusion

The study was conducted to determine the mean age of eruption of permanent teeth and to compare these findings with the results of earlier studies. Two thousand nine hundred and twenty five students from different schools were drawn as study samples. The results of the study are summarized here.

The mean age of eruption of permanent teeth is as follows:

- *Upper jaw*
First molar (6.9 ± 0.7 years), Central incisor

(7.8 ± 0.8 years), Lateral incisor (8.8 ± 0.8 years), First premolar (10.7 ± 1.0 years), Second premolar (11.5 ± 0.9 years), Canine (11.6 ± 0.9 years) and Second molar (12 ± 0.8 years).

- *Lower jaw*

First molar (6.3 ± 0.8 years), Central incisor (7.5 ± 0.8 years), Lateral incisor (7.9 ± 0.7 years), Canine (10.8 ± 0.8 years), First premolar (11.1 ± 0.5 years), Second premolar (11.8 ± 0.8 years) and Second molar (11.9 ± 0.7 years).

2. The earliest permanent tooth to erupt in both boys and girls is the first molar, whereas the second premolars, the maxillary canines and the second molars tended to be last to erupt in the sequential order.
3. The mandibular teeth tended to erupt earlier than the corresponding maxillary teeth in both sexes except the premolars
4. The sequence of eruption in the upper jaw differs from that in the lower jaw, however, the order of eruption is same in both sexes.
5. The mean time of eruption of the corresponding right and left teeth do not differ significantly in either the upper or lower jaws in both sexes.

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