ORIGINAL ARTICLE

Review of Estimation of Age from Eruption of Teeth in the Age-group 6-11 years

Bandyopadhyay S,[1] Bose TK,[2] Paul P.[3]

Assistant Professor,[1] Professor,[2] Postgraduate trainee.[3]

1. Department of Forensic Medicine, Mata Gujri Memorial Medical College, Kishanganj.

2. Forensic Medicine, Jagannath Gupta Institute of Medical Sciences and Hospital, Budge Budge , Kolkata.

3. Department of Pharmacology, Mata Gujri Memorial Medical College, Kishanganj.

Abstract:

Estimation of age is a valuable tool to assist in administration of justice in civil and criminal cases. Children with undocumented birth date are vulnerable to violation of various child rights. Dental techniques for estimation of age are currently considered the best in assessing true chronological age as dental development is less affected than skeletal development by malnutrition and hormonal disorders. Estimation of age by eruption of teeth is the best choice as it is non-invasive and more economical. To study the age of eruption of permanent teeth of children in the age-group 6-11 years of both sexes of Kolkata. To compare the findings with the time of eruption determined from previous studies and note any variations in age of eruption of teeth in relation to sex, socio-economic status, food habits. An observational, cross sectional, institution based, descriptive study on 144 school-going children of age group 6 years to 11 years randomly from various schools in Kolkata was done for the eruption of permanent teeth. Number of teeth erupted was observed and noted as per FDI chart. Data collected during the study was tabulated and verified using standard statistical tools. Out of a total 144 children 72(50%) were male children and 72(50%) were female children in the age group of 6-11 years. Eruption times of permanent teeth were noted in various age groups. According to the present study there has been no significant change in the age of eruption of permanent teeth over the years. The earliest tooth to erupt is the first mandibular molar. Permanent teeth erupted few months earlier in females as compared to males. Permanent teeth appeared earlier in the lower jaw than in upper jaw except first premolar on the left side. Majority of the teeth erupted earlier in the left quadrant as compared to the right quadrant.

Keywords: Age estimation; Tooth eruption; Child rights.

Introduction:

Estimation of age is a valuable tool to assist in administration of justice in civil and criminal cases. It is required in identification, consent, criminal responsibility, kidnapping, attainment of majority, judicial punishment, rape, criminal abortion, prostitution.[1] Age limits are important for admission in schools, for participating in various competitive sports like swimming and talent search contests.

In a developing country like India, due to illiteracy there is unawareness regarding importance of registration of births and often maintenance of records is improper. Children with undocumented birth date are vulnerable to violation of various child rights eg. child labour. Article 24 states that no child below the age 14 years shall be employed in work in any factory or mine or engaged in any other hazardous employment.[2-4] Due to globalization in most of the industrialized nations there is an influx of immigrants , for whom often a clear documentation of age is not available. Hence scientific determination of age is very important. Tooth formation is considered   best in assessing chronological age   as variations are less as compared to other developmental factors.[5,6] Dental development is less affected than skeletal development by malnutrition and hormonal disorders. In ancient times, age estimations of living adolescents were considered important. In ancient Rome, adolescents were judged to be fit for service, as soon as the second molars had erupted completely.[7] 170 years ago tooth eruption was first used for age estimation in connection with child labor. Assessment of tooth development to estimate the age of living subjects was used in 19th century industrial revolution in England.[8,9] Dental age assessment can be done   radiographically and clinical visualization of eruption of teeth. The times of eruption of teeth are fairly constant. Estimation of age by eruption of teeth is the best choice as it does not require any special equipment, expertise, is non-invasive and more economical. Variation exists in the eruption times of permanent teeth due to racial, geographical, nutritional, genetic, hormonal, nutritional, socio-economic factors.[10-12]

Earlier charts and tables were used for the assessment of age based on formation, eruption and calcification of teeth. Table of Krenfild and Logan, later modified by Kronfild and Schour (1939) is commonly used and accepted for many years. These were reviewed by Mcdonald and Avery (1998). These data when reviewed by Lund and Law, established earlier ages than the previously accepted value. The last study was done in West Bengal in 1992 by Banerjee P. and Banerjee A.R. Over the years there has been change in climate, lifestyle and food habits. My hypothesis is that these factors will affect the pattern of eruption

Corresponding Author
Dr. Soma Bandyopadhyay
Email: banerjeesoma65@yahoo.com
Mobile No.: +91- 9831270528

of permanent teeth. The purpose of this study is to note the age of eruption of permanent teeth at present in children of Kolkata in the age-group 6-11 years in both sexes and observe if there is any variation from the available data in standard textbooks, and the relationship of eruption of permanent teeth with sex, socio-economic status and food habit.

AIM: To study the age of eruption of permanent teeth of children in the age-group 6-11 years of both sexes of Kolkata.

Objectives: To compare the findings with the time of eruption determined from previous studies and note any variations in age of eruption of teeth in relation to sex, socio-economic status, food habits.

Materials and methods:

This is an observational, cross sectional, institution based, descriptive, study done in schools in Kolkata and its suburbs (3 boys' and 3 girls' schools were selected each from different socio-economic strata) from 1st April 2016 - 31st March 2017. 144 school-going children of age group 6 years to 11 years were studied randomly from various schools in Kolkata for the eruption of permanent teeth and their relation with age, sex, socio-economic status, food habit. The ethical clearance was obtained from the institutional Ethical Committee Review Board. Prior to the procedure, permission was obtained from the Principal of the school. Informed written consent was obtained from the parents on behalf of the children and assent was also obtained from the study children in accordance with Helsinki Declaration.[13]

Inclusion criteria: Children of age group 6-11 years with

Table 1. Mean age of eruption and standard deviation of each tooth of the subjects.

Teeth	Age of eruption (in years) (mean ± s.d)
Upper central incisor (Rt)	7.60±1.49
Upper central incisor (Lt)	7.46±1.22
Lower central incisor (Rt)	7.42±1.48
Lower central incisor (Lt)	7.22±1.32
Upper Lateral Incisor (Rt)	8.23±1.37
Upper Lateral Incisor (Lt)	8.22±1.39
Lower Lateral Incisor (Rt)	8.09±1.42
Lower Lateral Incisor (Lt)	8.05±1.43
Upper Canine (Rt)	11.50±1.08
Upper Canine (Lt)	11.66±0.89
Lower Canine (Rt)	11.69±0.70
Lower Canine (Lt)	11.52±0.79
Upper 1st Premolar (Rt)	9.99±1.11
Upper 1st Premolar (Lt)	9.78±1.22
Lower 1st Premolar (Rt)	10.09±0.96
Lower 1st Premolar (Lt)	9.97±0.97
Upper 2nd Premolar (Rt)	10.60±0.96
Upper 2nd Premolar (Lt)	10.52±0.97
Lower 2nd Premolar (Rt)	10.58±0.73
Lower 2nd Premolar (Lt)	10.60±0.72
Upper 1st Permanent Molar (Rt)	6.94±1.49
Upper 1st Permanent Molar (Lt)	6.83±1.55
Lower 1st Permanent Molar (Rt)	6.85±1.54
Lower 1st Permanent Molar (Lt)	6.68±1.65

Table 2. Mean age of eruption and standard deviation of each group of teeth.

Teeth	Mean	S.D
Central Incisor	7.4	1.31
Lateral Incisor	8.1	1.4
Canine	11.6	0.9
First Premolar	9.9	1.1
Second Premolar	10.6	0.8
First Permanent Molar	6.8	1.5

Table 3. Comparison of mean age of eruption of teeth of male and female subjects.

Teeth	Female	Male	p-value
	Age of eruption (in years) (mean ± s.d)	Age of eruption (in years) (mean ± s.d)	
Upper central incisor (Rt)	7.57±1.44	7.72±1.49	>0.05 NS
Upper central incisor (Lt)	7.27±1.23	7.56±1.22	>0.05 NS
Lower central incisor (Rt)	7.38±1.37	7.66±1.48	>0.05 NS
Lower central incisor (Lt)	7.14±1.27	7.42±1.32	>0.05 NS
Upper Lateral Incisor (Rt)	8.11±1.14	8.54±1.37	>0.05 NS
Upper Lateral Incisor (Lt)	8.17±1.34	8.28±1.39	>0.05 NS
Lower Lateral Incisor (Rt)	8.02±1.39	8.18±1.42	>0.05 NS
Lower Lateral Incisor (Lt)	8.04±1.22	8.22±1.43	>0.05 NS
Upper Canine (Rt)	11.34±1.14	11.58±1.06	>0.05 NS
Upper Canine (Lt)	11.24±0.87	11.82±0.83	>0.05 NS
Lower Canine (Rt)	11.46±0.72	11.73±0.71	>0.05 NS
Lower Canine (Lt)	11.32±0.67	11.63±0.77	>0.05 NS
Upper 1st Premolar (Rt)	9.27±1.17	9.85±1.13	>0.05 NS
Upper 1st Premolar (Lt)	9.66±1.30	9.83±1.27	>0.05 NS
Lower 1st Premolar (Rt)	9.89±1.06	10.24±0.93	>0.05 NS
Lower 1st Premolar (Lt)	9.77±0.84	9.89±0.92	>0.05 NS
Upper 2nd Premolar (Rt)	10.34±0.81	10.62±0.68	>0.05 NS
Upper 2nd Premolar (Lt)	10.28±0.82	10.56±0.97	>0.05 NS
Lower 2nd Premolar (Rt)	10.33±0.71	10.60±0.63	>0.05 NS
Lower 2nd Premolar (Lt)	10.42±0.63	10.57±0.66	>0.05 NS
Upper 1st Permanent Molar (Rt)	6.77±1.32	6.84±1.32	>0.05 NS
Upper 1st Permanent Molar (Lt)	6.63±1.44	6.93±1.45	>0.05 NS
Lower 1st Permanent Molar (Rt)	6.70±1.52	6.92±1.44	>0.05 NS
Lower 1st Permanent Molar (Lt)	6.46±1.41	6.77±1.42	>0.05 NS

Though most of the teeth of the females erupted a few months earlier than that of males t-test showed that there was no significant difference in mean age of eruption of males and females (p>0.05).

documented record of date of birth.

Exclusion criteria: Children with disease affecting dentition (rickets, malnutrition, hypothyroidism). Children having any surgical procedure in teeth and gums. Congenital disorders involving maxillofacial region e.g. Cleft palate. Children who had medications which can alter dental eruption. Those children whose parents did not give consent. Age (from standard record of date of birth), sex, weight, height, time of eruption of teeth were noted. The basic information about the children was recorded from the school record. A questionnaire was provided to each child regarding their food habit. Only those children were selected who had documented record of date of birth. The weights of the children were noted. The height of the children was measured from the child's head with the help of measuring scale.

Their teeth were examined visually for eruption. The recently erupted permanent teeth were identified on right and left quadrants in both upper and lower jaw. A tooth was considered erupted, if it has pierced through gums and un-erupted if not present in oral cavity. After examination of teeth, statistical tables
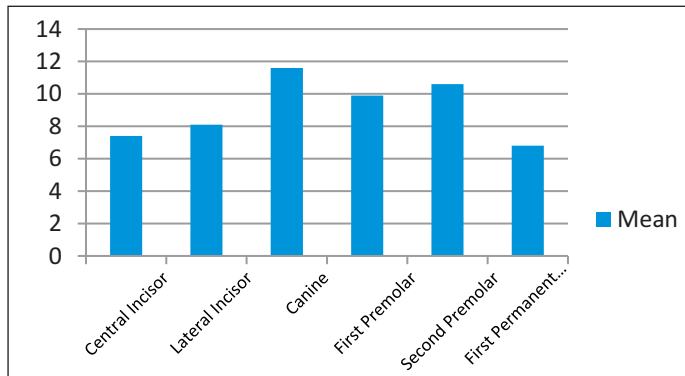
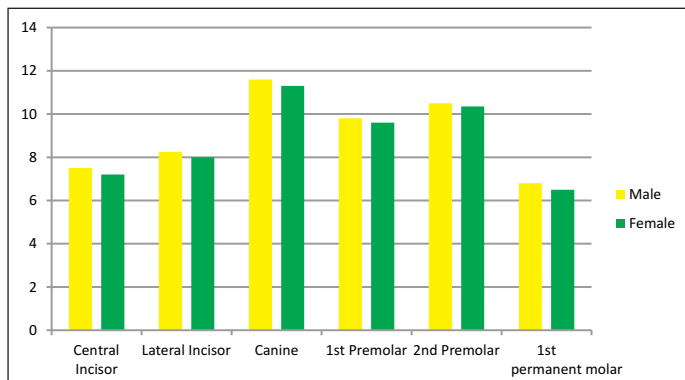**Figure 1. Mean age of eruption of each group of teeth.**

Figure 2. Difference in age of eruption between male and female.

Figure 3. Difference in age of eruption between upper and lower jaw.

Figure 4. Difference in age of eruption between right and left jaw.

Table 4. Comparison of mean age of eruption of teeth of upper jaw and lower jaw of the subjects.

Teeth	Lower Jaw	Upper Jaw	p-value
	Age of eruption (in years) (mean±s.d)	Age of eruption (in years) (mean±s.d)	
Central incisor (Lt)	7.08±1.19	7.37±1.38	>0.05 NS
Central incisor (Rt)	7.24±1.32	7.91±1.46	>0.05 NS
Lateral Incisor (Lt)	8.16±1.29	8.64±1.41	>0.05 NS
Lateral Incisor (Rt)	8.12±1.30	8.19±1.37	>0.05 NS
Canine (Lt)	11.22±0.54	11.44±0.47	>0.05 NS
Canine (Rt)	11.16±0.68	11.59±0.66	>0.05 NS
1st Premolar (Lt)	10.47±0.78	9.71±0.90	<0.05 S
1st Premolar (Rt)	10.61±1.17	9.98±0.56	<0.05 S
2nd Premolar (Lt)	10.74±0.58	10.10±0.49	<0.05 S
2nd Premolar (Rt)	10.86±0.87	10.15±0.62	<0.05 S
1st Permanent Molar (Lt)	6.24±1.43	6.68±1.42	>0.05 NS
1st Permanent Molar (Rt)	6.62±1.58	6.88±1.44	>0.05 NS

Most of the teeth of the lower jaw erupted a few months earlier than that of upper jaw except 1st and 2nd premolar which erupted significantly earlier in the upper jaw. t-test showed that there was no significant difference in mean age of eruption of the other teeth in the upper and lower jaw ($p>0.05$).

were prepared for mean age, range and Standard deviation for eruption of each tooth in the upper and lower jaw and also for right and left quadrants of the same jaw and a comparison was done and the data was then statistically analysed. (tables 1,2,3,4,5 and figures 1,2,3,4)

Result & Discussion:

The present study was conducted from April 2016 to March 2017. 144 school-going children were examined randomly from various schools under the jurisdiction of Kolkata corporation. Out of a total 144 children 72(50%) were male children and 72(50%) were female children in the age group of 6-11 years. In this study the earliest tooth to erupt is the first mandibular molar of the left quadrant at the age of 6.68 years followed by first mandibular molar of the right quadrant (5.90 years); the earliest tooth to emerge in the maxilla is first molar of the left quadrant (6.00 years). Central incisors erupted between 7.22 to7.60 years in both right and left halves of upper and lower jaws. The mean age of eruption was 7.15 +/- 1.25 years in the lower jaw and 7.6 +/- 1.42 years in the upper jaw. Lateral incisors erupted between 8.05 to 8.23 years in both halves of upper and lower jaws. The mean age of eruption was 8.14 +/- 1.30 years in the lower jaw and 8.40+/- 1.39 years in the upper jaw. First premolars erupted at the age of 9.78 to 10.09 years in both halves of upper and lower jaws with the mean age of eruption 9.74 ± 0.97 years for the lower jaw and 10.01 ± 0.77 years for the upper jaw. Second premolars erupted between 10.52 to 10.60 years in both halves of upper and lower jaws. The mean age of eruption was 10.35 +/- 0.75 years for the lower jaw and 10.53 =/- 0.55 years for the upper jaw. Canines erupted at the age between 11.50 to 11.69 years for both halves of
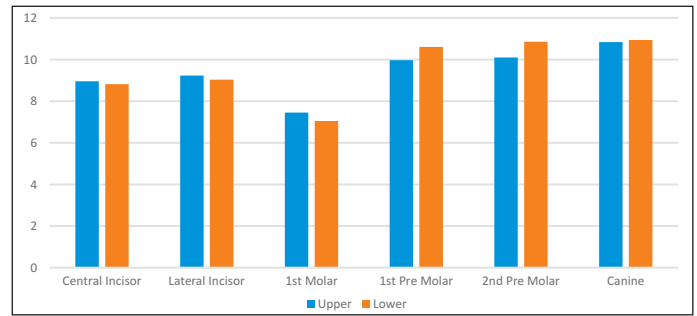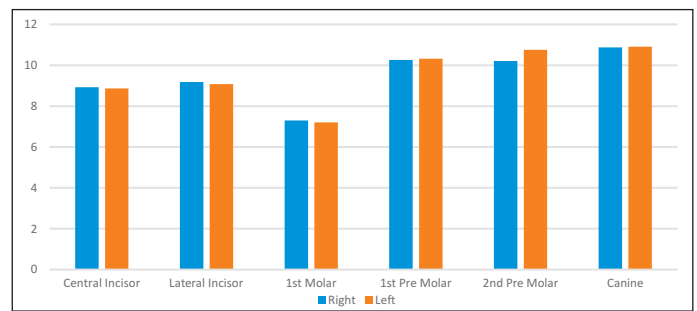
the upper and lower jaws with the mean age of eruption 11.19± 0.61 years for the lower jaw and 11.50 ± 0.57years for the upper jaw (table 1 and table 2).

The findings of my study regarding age of eruption of permanent teeth in the age-group 6-11 years is consistent with the available data in standard textbooks. There has been no significant change in the age of eruption of permanent teeth over the years. The present study confirms the previous reports among several Indian populations that the earliest tooth to erupt is the first mandibular molar. Several studies have also reported that the mandibular teeth erupt earlier than their maxillary counterparts.[3,5,7,10,15,16] The results were similar to the findings of the study conducted by Chaurasia in 2004. He found that the permanent teeth eruption starts in the form of first permanent molar at 6 years, C.I.- 7 years,

Table 5. Comparison of mean age of eruption of teeth of left side of jaw and right side of jaw of the subjects.

Teeth	Left	Right	p-value
	Age of eruption (in years) (mean±s.d)	Age of eruption (in years) (mean±s.d)	
Upper central incisor	7.47±1.44	7.82±1.33	>0.05 NS
Lower central incisor	7.18±1.37	7.78±1.26	>0.05 NS
Upper Lateral Incisor	8.07±1.14	8.42±1.23	>0.05 NS
Lower Lateral Incisor	8.09±1.39	8.24±1.40	>0.05 NS
Upper Canine	11.17±1.14	11.46±1.18	>0.05 NS
Lower Canine	11.16±0.72	11.34±0.66	>0.05 NS
Upper 1st Premolar	9.19±1.17	9.66±1.14	>0.05 NS
Lower 1st Premolar	9.78±1.06	10.17±0.87	>0.05 NS
Upper 2nd Premolar	10.68±0.81	10.18±0.64	<0.05 S
Lower 2nd Premolar	10.75±0.71	10.27±0.59	<0.05 NS
Upper 1st Permanent Molar	6.62±1.32	6.76±1.27	>0.05 NS
Lower 1st Permanent Molar	6.38±1.52	6.42±1.41	>0.05 NS

*Statistically Significant,   NS- Statistically Not Significant

Most of the teeth of the left side of jaw erupted a few months earlier than that of right of jaw except 2nd premolar which erupted significantly earlier in the right jaw. t-test showed that there was no significant difference in mean age of eruption of the other teeth in the left side and right side (p>0.05).

L.I. – 8 years, first premolar- 9 years, second premolar – 10 years, permanent canine- 11 years. It was observed that permanent teeth erupted few months earlier in females as compared to males. Permanent teeth appeared earlier in the lower jaw than in the upper jaw except first premolar on the left side. Permanent teeth appeared few months earlier in the left quadrant compared to the right quadrant. These findings were consistent with the findings of Sharma and Mittal (2001) who studied Gujjar children between 6 to 13 years of age. They found that eruption is earlier in females and that mandibular teeth except premolars tend to emerge earlier than their maxillary counterparts. The findings of this study were consistent with those of Subramanyam in 2001. He found that permanent teeth appear few months earlier in girls than in boys and peranent teeth appear earlier in the lower jaw.[17]

Conclusion:

First permanent teeth to erupt were the first permanent molars at the age between 6.68 to 6.94 years in both halves of upper and lower jaws. Permanent central incisors erupted between the age of 7.22 to 7.60 years for both halves of upper as well as lower jaw. Permanent lateral incisors erupted between the age of 8.05 to 8.23 years in both halves of upper and lower jaws. First premolars erupted between the age of 9.78 to 10.09 years for both halves of upper and lower jaw Second premolars erupted between 10.52 to 10.60 years for both halves of upper and lower jaw. Canines erupted between 11.50 to 11.69 years for both halves of upper and lower jaw. Eruption of permanent teeth were earlier in the lower jaw than that of the upper jaw except 1st premolar (left) which showed earlier eruption in the upper jaw as compared with the lower jaw. Co-relation of eruption of permanent teeth with sex showed earlier eruption times of all the permanent teeth in females as compared with males.

References:

1. Kumar CL, Sridhar MS. Estimation of the age of an individual based on times of eruption of permanent teeth. Forensic Sci Int. 1990;48:1–7.

2. UNICEF. Child Protection [Internet]. www.unicef.org. 2022. Available from: https://www.unicef.org/child-protection.

3. Article 24 Constitution of India: Prohibition of employment of children in factories, etc. [Internet]. latestlaws.com. [cited 2023 Jun 29]. Available from: https://www.latestlaws.com/bare-acts/central-acts-rules/coi-article-24-prohibition-of-employment-of-children-in-factories-etc-/

4. Child Labour & Child Rights in India: Myth or Reality [Internet]. www.oxfamindia.org. Available from: https://www.oxfamindia.org/blog/child-labour-india

5. McDonald and Avery's Dentistry for the Child and Adolescent | ScienceDirect [Internet]. www.sciencedirect.com. Available from: https://www.sciencedirect.com/book/9780323287456/mcdonald-and-averys-dentistry-for-the-child-and-adolescent

6. Gordon I, Turner R, Price TW. Medical jurisprudence. 3rd ed. Edinburgh and London: Livingstone Ltd; 1953. pp. 343–72.

7. Schmeling A, Olze A, Reisinger W, Geserick G. Forensic age diagnostics of living people undergoing criminal proceedings. Forensic Sci Int. 2004;144:243–5. [PubMed]

8. Legal Medicine, Pathology and Toxicology (ed. 2) T. A. Gonzales, M. Vance, M. Helpern, and C. J. Umberger. Appleton-Century-Crofts, Inc., New York, N. Y., 1349 pp., $22.00. 1955 Apr 1 [cited 2023 Jun 29];1(2):148–9.

9. Shah P, Velani PR, Lakade L, Dukle S. Teeth in forensics: A review. Indian J Dent Res. 2019;30:291-9.

10. Enwonwu CO. Influence of socio-economic conditions on dental development in Nigerian children. Arch Oral Biol. 1973;18:95–107.

11. Manjunatha BS, Soni NK. Estimation of age from development and eruption of teeth. J Forensic Dent Sci. 2014 May;6(2):73-6.

12. Seow K, Humphrys C, Mahanonda R, Tudehope D. Dental eruption in low birth-weight prematurely born children: a controlled study. Pediatric Dent. 1988;10:39–42. [PubMed]

13. Helm S, Prydso U. Assessment of age-at-death from mandibular molar attrition in medieval Danes. Scand J Dent Res. 1979;87:79–90. [PubMed]

14. World Medical Association: Declaration of Helsinki, version VI.2002.[http://www.wma.net/en/30publications/10policies/b3/17c.pdf]. Accessed on 8 November 2012.

15. Jayaraman J, King NM, Roberts GJ, Wong HM. Dental age assessment: are Demirjian's standards appropriate for southern Chinese children? J Forensic Odontostomatol. 2011 Dec 1;29(2):22-8.

16. George GJ, Chatra L, Shenoy P, Veena KM, Prabhu RV, Vagish Kumar LS. Age determination by schour and massler method: A forensic study. Int J Forensic Odontol 2018;3:36-9.

17. Sharma K, Mittal S. Permanent tooth emergence in Gujjars of Punjab, India. Anthropologischer Anzeiger [Internet]. 2001 [cited 2023 Jun 29];59(2):165–78. Available from: https://www.jstor.org/stable/29541011