A Cross-Sectional Study on Eruption Timing of Primary Teeth in Children of Mysore, Karnataka

Abstract
Context: Eruption of first primary teeth is the most anxiously awaited developmental milestone in a child. However, primary teeth have shown wide variations in their eruption time among different population, ethnic, and racial groups. Aims: The present study was conducted with the aim to evaluate the time and sequence of eruption of primary teeth of children of Mysore.
Settings and Design: A cross-sectional study design included 1392 participants aged 3 months to 36 months recruited by simple random sampling method. The variables such as age, gender, and number of erupted primary teeth were recorded. Subjects and Methods: Clinical examination was done under natural illumination. A tooth was considered erupted when any part of its crown had penetrated the gingiva and was visible in the oral cavity. Statistical Analysis Used: Probit regression analysis was performed to obtain the mean and median age of eruption of teeth. The significance of difference in the mean age of eruption across gender and arch was determined using paired t-test. Results and Conclusion: The first primary tooth to erupt was mandibular central incisor at 10.24 ± 2.47 months followed by maxillary central incisor at 11.06 ± 2.65 months. The duration of primary teeth eruption was 17.89 and 18.32 months in males, 18.54 months and 18.32 months in females for maxilla and mandible, respectively. Eruption of primary tooth is delayed among children of Mysore as compared to standard eruption chart. The results will provide information to health professional about contemporary tooth eruption time derived from an Indian population.

Keywords: Eruption time, Mysore, primary teeth

Introduction
Eruption of teeth is a continuous physiological process. It is a process, in which teeth move from their developmental position within the jaws to break the mucosa toward the oral cavity.[1] Researchers consider a tooth as erupted when as any part of the tooth crown penetrates the gingival tissue and is visible in the oral cavity.[2,3]

Parents consider eruption of first primary teeth as an important developmental milestone that has to be achieved by the child[4,5] and often seek pediatrician opinion if there is a delay. Studies have shown wide variations in the timing of primary teeth eruption. Iceland and Scandinavian children have similar mean age of eruption, whereas Saudi children show delay in eruption compared to Caucasian children.[6,7] Holman and Jones demonstrated that there are variations in the timing of eruption of primary teeth within the same geographic area also.[8] Studies on Indian children have also shown variation in the eruption of first primary teeth from 10.4 months to 14.5 months.[9-13] Other factors that influence the timing of eruption includes gender,[14] ethnic origin,[15] racial group,[16] gestational age,[17] systemic diseases,[18] hereditary factors, and nutritional status.[19]

The timing and sequence of eruption of primary teeth used in clinical, academic, and research areas in India are based on the populations from other parts of the world. The eruption timing of permanent dentition in different populations has been studied widely. However, only few studies have been published on primary dentition and a very few studies have investigated on timing of eruption of primary teeth in Indian population.

Since many factors vary from one geographic region to another, which might affect the timing of tooth eruption, it may be recommended not to adopt references from other countries as our standard; as Indians differ from them racially, culturally, and
environmentally. Eruption sequence can be a very valuable asset in the diagnosis and treatment planning during growth and development of child.[2] Dental age is the key factor for implementation of caries prevention programs such as topical fluoride application. Estimation of age by the number of teeth erupted has been recognized as having prime importance in demographic surveys, forensic sciences, and anthropology.[2] The present study was conducted with the objective to evaluate the time and sequence of eruption of primary teeth of children of Mysore.

**Subjects and Methods**

Children aged 3–36 months were recruited by simple random sampling method from outpatient department and immunization units of Department of Pediatrics from 2 major hospitals in Mysore. In a period of 6 months, a total of 1392 children were examined. Permission to conduct the study was obtained from the concerned departments. Ethical approval was taken from the Institutional Ethical Committee. Informed consent was obtained from the parents of all the children recruited for the study. To eliminate the effect of gestational age, socioeconomic status, and ethnicity, the following inclusion criteria were considered for the study.

(1) Children born full term and clinically healthy,
(2) birth weight 2.5–3.2 kg, (3) children were Mysoreans (>3 generations living in Mysore), and (4) children from same socioeconomic status (Kuppuswamy socioeconomic status class III).

Factors causing variation in the eruption timing such as chronic infectious diseases, nutritional and endocrinial disturbances, genetic diseases with recognized syndromes, and developmental malformations such as cleft lip and palate were excluded from the study.

**Methodology**

Principal investigator was calibrated using 30 participants. Intra-examiner reliability was found to be 100%. Later, these participants were excluded from the main study. Clinical examination of the participant was done under natural illumination using mouth mirror with the participant seated on their parent’s lap seated on an ordinary chair. A tooth was considered erupted when any part of its crown had penetrated the gingiva and was visible in the oral cavity.[19] Dental chartings were made according to the Federation Dentaire Internationale standards.

**Statistical method**

The data on age, gender, weight, and length along with various erupted tooth (teeth) was obtained on the sampled children. Probit regression analysis[20] was performed to obtain the mean, median age of eruption of each tooth for whole sample, as well as males and females independently. The significance of difference between the mean age of eruption for each tooth on the right and left maxillary arch as well as mandibular arch was determined using paired t-test. The analyses were performed independently for males and females. On similar lines, the significance of difference between mean length and mean weight at eruption of each tooth on the right and left arches was performed using paired t-test. The mean age of eruption of each tooth in males and females was compared for significance of difference using t-test for independent samples. The analyses were performed in R-programming language, and the significance was tested at 5% level.

**Results**

A total of 1392 children aged 3–36 months were included in the study. There were 778 (55.9%) males and 614 (44.1%) females. Most of the studies report either mean or median age of eruption. In our study, we have reported both mean and median age of eruption. Tables 1 and 2 shows the eruption ages in males and females, respectively.

When the eruption time on the right and left side were compared, the teeth on the right side erupted earlier than the left side, but they were not statistically significant. However, in females, maxillary canine and in males maxillary canine, mandibular lateral incisor, and mandibular first molar showed a statistically significant earlier eruption on the right side [Tables 1 and 2].

When the eruption ages among the males and females were compared, males showed statistically significant ($P < 0.001$)

| Tooth | Mean±SD | Median (SEM) | Tooth | Mean±SD | Median (SEM) | t  | P   |
|-------|---------|--------------|-------|---------|--------------|----|-----|
| 51    | 10.70±2.42 | 10.76 (0.24) | 61    | 10.70±2.49 | 10.98 (0.25) | −0.33 | 0.74 |
| 52    | 12.90±3.29 | 13.09 (0.33) | 62    | 12.90±3.39 | 13.03 (0.34) | −0.02 | 0.98 |
| 53    | 19.00±2.78 | 19.21 (0.28) | 63    | 19.14±2.85 | 18.89 (0.28) | −30.75 | <0.0001 |
| 54    | 15.88±2.86 | 15.89 (0.29) | 64    | 15.88±2.46 | 15.60 (0.25) | −0.08 | 0.93 |
| 55    | 28.62±3.03 | 28.82 (0.30) | 65    | 28.99±3.23 | 28.65 (0.32) | −17.32 | 0.96 |
| 81    | 10.20±2.77 | 10.24 (0.25) | 71    | 10.16±2.52 | 10.24 (0.25) | 0.53 | 0.59 |
| 82    | 15.66±3.68 | 15.89 (0.37) | 72    | 16.10±4.60 | 16.72 (0.46) | −7.83 | <0.0001 |
| 83    | 20.71±3.95 | 20.97 (0.39) | 73    | 20.79±3.71 | 20.20 (0.37) | 0.96 | 0.34 |
| 84    | 16.84±2.54 | 17.35 (0.25) | 74    | 16.87±2.53 | 17.13 (0.25) | −42.44 | <0.0001 |
| 85    | 28.28±3.67 | 28.40 (0.37) | 75    | 28.48±3.19 | 28.84 (0.32) | −14.09 | 0.71 |

SD=Standard deviation, SEM=Standard error of mean
earlier eruption in maxillary central and lateral incisors, maxillary molars, and mandibular canine compared to females [Table 3].

When the mean age of eruption was derived for the whole sample, there was no statistically significant difference between right and left quadrant. Hence, the data on right side is considered for the purpose of comparison with the other studies. Our study, results showed that the first primary tooth to erupt was mandibular central incisor at 10.24 ± 2.47 months followed by maxillary central incisor at 11.06 ± 2.65 months. Maxillary lateral incisor erupted at 13.16 ± 3.40 months and mandibular lateral incisor at 15.79 ± 3.95 months. Primary molars of both maxilla and mandible erupted earlier than canines at 16.06 ± 2.7 months and 17.25 ± 2.67 months, respectively, following the same eruption sequence as previous studies. Maxillary and mandibular second molar erupted at 29.05 ± 4.7 and 28.56 ± 3.14 months, respectively [Table 4]. The sequence of eruption of primary teeth was mandibular central incisor, maxillary central incisor, maxillary lateral incisor, mandibular lateral incisor, mandibular first molar, maxillary first molar, maxillary canine, mandibular canine, mandibular central incisor, mandibular second molar, and maxillary second molar.

The duration of primary teeth eruption (defined as the time taken for eruption from the first tooth to the last tooth) was 17.89 and 18.32 months for maxilla and mandible, respectively, in males whereas it was 18.54 months and 18.32 months for maxilla and mandible, respectively, in females [Table 5]. However, the variations among the genders were not statistically significant at 5% confidence level.

Eruption of primary teeth is described in four phases. Phase I (incisor eruption), Phase II (first molar eruption), Phase III (canine eruption), and Phase IV (second molar eruption). Although the males had an earlier eruption a catch-up growth was noticed during the eruption of canine [Tables 3 and 6].

Resting period is the time zone between two phases of eruption, where eruption does not occur. Minimum resting period is observed between Phase I and Phase II, whereas maximum resting period is between phase III and IV. Table 7 showed the country-wise comparison of resting period among males and females. Table 8 showed the comparison of mean age of primary teeth eruption with various countries while Table 9 shows comparison among the different states of India.

**Discussion**

Primary teeth eruption is one of the important milestones in child’s development. They are not only important for

### Table 2: Mean and median age of eruption of primary teeth in maxillary and mandibular arch in females

| Tooth                      | Mean±SD | Median (SEM) | Tooth                      | Mean±SD | Median (SEM) | t     | P       |
|----------------------------|---------|--------------|----------------------------|---------|--------------|-------|---------|
| 51                         | 11.54±2.59 | 11.44 (0.26) | 61                         | 11.70±2.21 | 11.71 (0.22) | −25.68 | 0.25    |
| 52                         | 13.48±2.63 | 13.95 (0.26) | 62                         | 13.59±3.40 | 13.37 (0.34) | −35.17 | 0.26    |
| 53                         | 18.97±2.25 | 18.80 (0.23) | 63                         | 19.31±2.57 | 19.54 (0.26) | −15.62 | 0.0001  |
| 54                         | 16.25±3.03 | 16.16 (0.30) | 64                         | 16.62±2.69 | 16.72 (0.27) | −11.08 | 0.23    |
| 55                         | 30.02±4.53 | 29.93 (0.45) | 65                         | 30.02±4.42 | 29.39 (0.44) | −10.41 | 0.32    |
| 81                         | 10.23±1.89 | 10.22 (0.19) | 71                         | 10.37±1.90 | 10.41 (0.19) | −10.41 | 0.32    |
| 82                         | 15.65±3.82 | 15.96 (0.38) | 72                         | 15.41±3.86 | 15.49 (0.39) | 0.0001 | 0.59    |
| 83                         | 21.85±2.50 | 21.96 (0.25) | 73                         | 21.85±2.65 | 21.63 (0.26) | −10.41 | 0.32    |
| 84                         | 17.05±3.09 | 16.70 (0.31) | 74                         | 17.05±2.97 | 16.79 (0.30) | −8.75  | 0.12    |
| 85                         | 28.68±3.50 | 28.67 (0.35) | 75                         | 28.68±3.44 | 28.54 (0.34) | 0.80   | 0.42    |

SD=Standard deviation, SEM=Standard error of mean *P<0.001 is statistically significant

### Table 3: Comparison of mean age of eruption of teeth in boys and girls

| Tooth position                  | Side (mean±SD), median (SEM) | t*    | P       |
|---------------------------------|-------------------------------|-------|---------|
| Maxillary central incisor       | 10.70±2.51, 10.98 (0.25)      | 6.6106 | <0.0001 |
| Maxillary lateral incisor       | 12.90±2.81, 12.78 (0.28)      | 4.1796 | <0.0001 |
| Maxillary canine                | 19.07±3.15, 19.05 (0.32)      | 0.4986 | 0.6181  |
| Maxillary first molar           | 15.88±2.69, 15.70 (0.27)      | 4.0858 | <0.0001 |
| Maxillary second molar          | 28.80±3.49, 28.75 (0.35)      | 5.9247 | <0.0001 |
| Mandibular central incisor      | 10.16±2.95, 10.05 (0.29)      | 1.0390 | 0.2990  |
| Mandibular lateral incisor      | 15.88±3.88, 15.95 (0.39)      | 1.7540 | 0.0797  |
| Mandibular canine               | 20.79±3.53, 20.66 (0.35)      | 5.9742 | <0.0001 |
| Mandibular first molar          | 16.86±2.87, 16.93 (0.29)      | 1.9300 | 0.0538  |
| Mandibular second molar         | 28.37±3.19, 28.42 (0.32)      | 1.7101 | 0.0875  |

SD=Standard deviation, SEM=Standard error of mean. *P<0.001 is statistically significant
maintaining facial contour, mastication, phonetics, and esthetics but also for guiding the secondary teeth into their proper position. Hence, accurate and standard tooth eruption charts are essential for child oral health-care planning, interceptive orthodontics, primary preventive treatment, and in the diagnosis of any growth variations. Although tooth eruption is genetically determined, it is influenced by racial, demographic, nutritional, and endocrine factors. As a result, there have been various reports in the literature focusing on the eruption of primary teeth. Lunt and Law[21] review of chronology of eruption of deciduous teeth has been accepted standard since 1974 and has been used clinically and academically in India.[21] Since the demographic, racial, and nutritional factors vary from one geographic location to another which might have an effect on primary tooth eruption,[14,15,18] it is preferable to have a standard eruption chart for Indians since we differ culturally and environmentally from other population. Literature search reveals variation in timing of eruption of primary teeth among different regions of India.[9‑13,22] It is clear from the literature that there are very few studies on the timing of eruption of primary teeth of Indian children, and those reported shows a huge variation in the timing of eruption of primary teeth[Table 9]. Since India is a multicultured and multiracial country, there is a need to generate eruption timing chart for primary teeth separately for different regions of India.

In the present study, age of eruption is represented in both mean and median. Statistically for a cross-sectional study expressing the age of eruption in median is more accurate than mean, however, for comparison with various other studies only the mean age is considered. Sexual differences in eruption of primary teeth are not clearly stated in the literature. Few authors report significant earlier eruption in males compared to females,[2] while Magnússon[6] reported significant earlier eruption in females.[6] In our study, maxillary and mandibular primary teeth erupted significantly earlier in males than females except for maxillary canine, mandibular incisors, and molars.

The sequence of eruption of primary teeth within the arch followed the same pattern as described in the previous studies. The sequence of eruption of primary teeth is as follows: maxillary central incisors followed by lateral incisors, mandibular central incisors followed by lateral incisors, maxillary canines, mandibular canines, maxillary premolars, maxillary first molars, mandibular premolars, and mandibular first molars.

### Table 4: Mean and median age of eruption of primary teeth in maxillary and mandibular arch (combined by gender)

| Tooth | Mean±SD (SEM) | Median (SEM) |
|-------|---------------|--------------|
| 51    | 11.06±2.65 (0.26) | 10.79 (0.26) |
| 52    | 12.52 (0.34) | 13.21±3.05 (0.31) |
| 53    | 19.92±2.98 (0.30) | 19.31 (0.30) |
| 54    | 16.41 (0.27) | 16.24±2.58 (0.26) |
| 55    | 29.61±3.72 (0.37) | 29.30 (0.37) |
| 56    | 10.87±0.25 (0.23) | 10.03 (0.23) |
| 57    | 15.73 (0.34) | 15.66±3.36 (0.34) |
| 58    | 21.50 (0.35) | 21.24±3.5 (0.35) |
| 59    | 16.61±0.27 (0.27) | 16.41 (0.27) |

SD=Standard deviation, SEM=Standard error of mean

### Table 5: Duration of eruption of primary teeth

| Quadrant          | Males | Females | Combined |
|-------------------|-------|---------|----------|
| Maxillary right   | 17.89 | 18.54   | 17.99    |
| Maxillary left    | 8.29  | 18.32   | 18.16    |
| Mandibular right  | 18.32 | 18.32   | 18.32    |
| Mandibular left   | 18.08 | 18.45   | 18.27    |

### Table 6: Resting time during phases of primary teeth eruption among male and female

| Phases     | Resting period 1 | Resting period 2 | Resting period 3 | Phase IV |
|------------|------------------|------------------|------------------|----------|
| Males      |                  |                  |                  |          |
| Maxillary  | 12.90            | 3.19             | 19.07            | 9.73     | 28.80 |
| Mandibular | 15.88            | 3.93             | 20.79            | 7.52     | 28.37 |
| Females    |                  |                  |                  |          |
| Maxillary  | 13.54            | 2.72             | 19.15            | 10.87    | 30.02 |
| Mandibular | 15.53            | 4.70             | 21.85            | 6.83     | 28.68 |
| Combined   |                  |                  |                  |          |
| Maxillary  | 13.16            | 2.96             | 19.02            | 10.03    | 29.05 |
| Mandibular | 15.79            | 3.99             | 21.24            | 7.32     | 28.56 |

### Table 7: Comparison of resting time in maxilla and mandibular arches in different countries

| Phases     | Mean intervals (months) |
|------------|-------------------------|
| Present study | India, 2015 | Saudi Arabia, 2003[9] | Nepal, 2007[10] | Nigeria, 2007[11] | Egypt, 2011[12] |
| Maxilla    | 3.7          | 3.7          | 3.64         | 3.5         | 3.2         |
| Mandible   | 2.6          | 3.9          | 3.11         | 3.4         | 2.1         | 2.3         |
| Maxilla    | 2            | 4            | 2.99         | 2.1         | 3.5         | 3.2         |
| Mandible   | 6            | 4            | 5.45         | 4.97        | 5.9         | 5           |

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Table 8: Comparison of mean age of eruption (standard deviation) in months of primary teeth of males and females with various countries

| Country                  | Male (Mean ± SD) | Female (Mean ± SD) |
|--------------------------|------------------|--------------------|
| Present study, 2015      | 51.7 ± 3.2, 54.2 ± 2.6 | 11.8 ± 0.7, 11.5 ± 0.8 |
| Iceland, 1982[6]         | 52.3 ± 2.9, 53.8 ± 2.6 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Saudi Arabia, 2003[7]    | 53.4 ± 3.0, 52.8 ± 2.6 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Nepal, 2007[16]          | 54.5 ± 2.8, 55.2 ± 3.0 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Nigeria, 2007[1]         | 55.3 ± 3.0, 56.2 ± 2.8 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Egypt, 2011[3]           | 56.5 ± 3.0, 57.2 ± 2.8 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Combined                 | 53.9 ± 2.9, 54.5 ± 2.8 | 11.9 ± 0.7, 11.9 ± 0.8 |

Table 9: Comparison of mean age of eruption (in months) of primary teeth among different states of India

| State                      | Male (Mean ± SD) | Female (Mean ± SD) |
|----------------------------|------------------|--------------------|
| Present study, 2015        | 51.7 ± 3.2, 54.2 ± 2.6 | 11.8 ± 0.7, 11.5 ± 0.8 |
| Gulbarga, 1981[8]          | 52.3 ± 2.9, 53.8 ± 2.6 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Andra Pradesh, 2010[9]     | 53.4 ± 3.0, 52.8 ± 2.6 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Jharkhand, 2016[10]        | 54.5 ± 2.8, 55.2 ± 3.0 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Patiala, 2004[11]          | 55.3 ± 3.0, 56.2 ± 2.8 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Mangalore, 2014[12][13]    | 56.5 ± 3.0, 57.2 ± 2.8 | 12.0 ± 0.7, 12.0 ± 0.8 |
| Combined                  | 53.9 ± 2.9, 54.5 ± 2.8 | 11.9 ± 0.7, 11.9 ± 0.8 |

SD: Standard deviation

The first tooth that erupted in our study was mandibular central incisors at 10.32 months which was 3–4 months later than standard eruption table followed universally.[33]

In our study, Phase I completed within 5.6 months. Resting interval of 2.9 and 1.46 months in maxilla and mandible, respectively, before the Phase II (first molar eruption), between Phase II and III (canine eruption) resting period of 2.96 months in maxilla and 3.99 months in mandible was noted. The last phase (second molar eruption) occurred after 10.3 and 7.32 months in the maxilla and mandible, respectively.

In our study, resting interval between Phase I and Phase II was shorter when compared to Saudi Arabia, Nigeria, and Egypt in both maxilla and mandible. Resting interval between Phase II and Phase III was shorter compared to Nepalian children but longer when compared to Nigerian and Egyptian children in both the arches. However, resting interval between Phase III and Phase IV was the longest in our study compared to all the other studies [Table 5].

Females had shorter resting period between Phase I–Phase II and Phase II–Phase III in the maxilla compared to males. This allowed for the catch-up growth in females during the eruption of canines. However, males had a shorter resting Phase III–Phase IV in both the arches [Table 5] in this study. These findings are similar to that of Infante[24] and Oziegbe.[19] Miller and Burdi[33] have explained that during the intrauterine life, females are normally behind in relation to males and remain so till the time of eruption of lateral incisor. Females then catch up growth in dental development and remain so till the completion of primary dentition and permanent tooth eruption. However, there are no published literatures on the phases of eruption of primary teeth in Indian children to compare.

Conclusion

From this study, it can be concluded that eruption of primary tooth is delayed by 3–4 months as compared to standard eruption chart used most commonly in our clinical, academic, and research areas. Our study findings will provide information to pediatricians and pedodontists with about contemporary tooth eruption time derived from an Indian population, which can be used for assessing dental growth and development of children in India, particularly in Mysore population. However, further research is required to evaluate the effect of socioeconomic status, gestational age, and birth weight on the eruption of primary teeth.
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Conflicts of interest
There are no conflicts of interest.

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