ORIGINAL ARTICLE

# Comparison of Permanent Teeth Eruption by Chronological Age in Indonesian Children

Pratiwi Soesilawati[1,2,3], Nisa Adei Putri Rahmawati[4], Yuangga Intania Sheindy Raharjo[4], Tsuroyya Aprilia Salsabila[4], Khamidah Imania[4], Alvin Phen[4], Rahmad Yuliantoro[4], Soegeng Wahluyo[5], Aspalilah Alias[6]

[1] Department of Oral Biology, Faculty of Dental Medicine, Universitas Airlangga, 60132, Surabaya, Indonesia
[2] Cell and Tissue Bank-Regenerative Medicine, Dr Soetomo General Academic Hospital / Faculty of Medicine, Universitas Airlangga, 60132, Surabaya, Indonesia
[3] Immunology Program, Postgraduate School, Universitas Airlangga, 60132, Surabaya, Indonesia
[4] Undergraduate Student, Faculty of Dental Medicine, Universitas Airlangga,60132, Surabaya, Indonesia
[5] Department of Pediatric Dentistry, Faculty of Dental Medicine, Universitas Airlangga, 60132, Surabaya, Indonesia
[6] Department of Basic Science and Oral Biology, Faculty of Dentistry,University Sains Islam Malaysia, 56100 Kuala Lumpur,Malaysia

## ABSTRACT

**Introduction:** The eruption of permanent teeth can be a reference for determining, measuring, and estimating the age and sex of a person which can help support Forensic Odontology in the diagnosis, treatment planning, and the body of the unknown and can be used as an estimate of age for children. To compare teeth eruption sequence between girls and boys to determine the accuracy of the average age, sequence of eruption of permanent teeth in children and the relationship to chronological age for the indicator of age determination. **Methods:** A total of 40 dental model study from patient aged 6-12 years in Airlangga Dental Hospital Surabaya were examined for the tooth eruption timing to identify elements of erupted permanent teeth. The results were obtained by calculating the sample size using a formula to obtain the average age of the eruption of permanent teeth in boys and girls. Furthermore, the results were compared. **Results:** In general, the maxillary and mandibular of girls erupted more rapidly than boys, with the first molars in all tooth regions being the first to erupt, and the second molars being the last to erupt. **Conclusion:** The results of the sequence of eruption patterns of permanent teeth can be used as a reference to determine the chronological age and sex of the child and further research is needed in large populations with ethnic and socio-economic variations to determine age differences. from the eruption of the tooth.

**Keywords:** Human and health, Age estimation, Chronological age, Dental age, Eruption sequence, Forensic

**Corresponding Author:**
Pratiwi Soesilawati, PhD
Email: pratiwi-s@fkg.unair.ac.id
Tel: +62 31 503 0255

## INTRODUCTION

Teeth eruption especially at the ages of children to teenagers can be observed in the identification process(1). Tooth eruption is defined as the movement of a tooth, primarily in the axial direction, from its site of development in the jaw bone to its functional position in the oral cavity(2). Dental development in children starts from deciduous teeth to permanent teeth. The development of erupted permanent teeth in children can be an estimate of their chronological age (3). Chronological age (CA) estimation is not only used for forensic dentistry but also for living subjects, human anthropology and bioarchaeology. Especially the odontological age estimation method which is based on the development, morphology, and changes of biochemical teeth(4,5,6,7) Tooth eruption can be an indicator that can be observed easily, because the eruption of primary and permanent teeth has a fairly fixed period. Teeth are also known to help a person's identification and approximate age because it is very durable and resistant to decay, fire, and chemicals. Thus, a dental examination is one of the acceptable methods of determining age (8).

The sequence time of eruption of the teeth of girls and boys has a significant difference. The main difference is that the mandibular canines in girls grow faster than boys. There are differences in the sequence of teeth appearance which can also be caused by several things,

namely fluoride intake, caries, premature extraction of primary teeth, physical, nutritional, socioeconomic status, gender, climate and environmental factors(9,10). From the above background, this study was conducted to measure the estimated age using the tooth eruption indicator. This research was conducted by storing the permanent teeth of the upper and lower jaws of children aged 6-12 years in Surabaya. Clinical examination is performed to identify elements of the erupted permanent teeth. Furthermore, the average value of each tooth element was taken, which described the mean age and gender at the time of eruption. This study hypothesizes that indicators of permanent tooth eruption can be used as a guide for determining age and gender in forensic odontology.

## METHODS AND MATERIALS

This study was an observational study. The sample consisted of 40 dental model study, from 20 girls and 20 boys patients in Airlangga Dental Hospital, Surabaya since November 2020 until June 2021. The reason of using this dental model study including their dental medical records because the research was carried out during pandemic COVID 19 and it was not possible to examine patients directly. The sample criteria included children aged 6-12 years in mix dentition with at least 1 erupted permanent tooth. Data of birth, as identified on dental medical status. Observations were carried out by observasional inspection of every dental model study. The inspection was done both on dental model study and periapical radiographic on dental medical status to collect data regarding the eruption time of permanent teeth. The controlled variables were systemic health, socio-economic level, and nutrition level. The independent variable was the age of eruption teeth, and the dependent variable was the chronological age. Data research data were analysed as mean ± SD. Statistical differences were calculated using Shapiro-Wilk for normality test, the Levene's homogeneity test, and the independent T-comparison test for comparison test with $p \leq 0.05$ was measured as statistically significant. This research was approved by Health Reseach Ethical Clearance Commission, Universitas Airlangga Faculty of Dental Medicine Number 333/HERCC.FODM/VI/2021.

## RESULTS

The result of this research showed there was a difference in time sequence of eruption teeth between boys and girls, that was proved by the value of $p > 0.05$.

In the mandibular region, teeth 31, 32, 33, 36, 37, 41, 42, 43, 46, and 47 of girls erupted faster than boys, even though at teeth 31, 41, and 47, the difference was not very significant. While on teeth 34, 35, and 44 of boys erupted faster than girls. (Table I (A)).
In the maxillary region, 21, 22, 23, 24, 25, 26, 11, 12, 13, 14, 15, 16, 17 of girls erupted faster than boys. Tooth 27 of boys is the only tooth that erupted faster than girls. (Table I (B)).

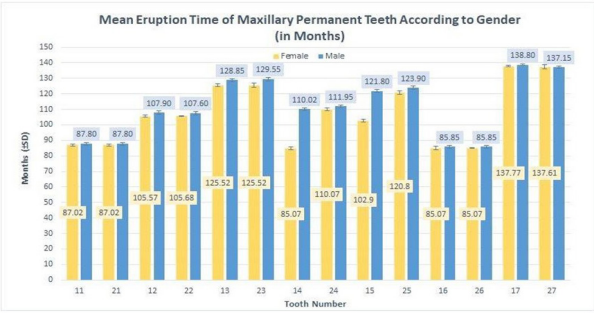
**Table I (A).** Mean eruption time on mandible

| Tooth Number | Tooth Name | Mean Eruption Time ± SD (months) | |
|---|---|---|---|
| | | Female | Male |
| 41 | Right Central Incisor | 87.00 ± 0.367 | 87.80 ± 0.907 |
| 31 | Left Central Incisor | 87.00 ± 0.367 | 87.80 ± 0.907 |
| 42 | Right Lateral Incisor | 87.35 ± 0.647 | 107.90 ± 1.193 |
| 32 | Left Lateral Incisor | 87.22 ± 0.678 | 107.60 ± 1.190 |
| 43 | Right Canine | 109.77 ± 0.88 | 128.85 ± 1.041 |
| 33 | Left Canine | 109.76 ± 0.708 | 129.55 ± 1.031 |
| 44 | Right 1st premolar | 125.78 ± 1.16 | 110.02 ± 1.046 |
| 34 | Left 1st premolar | 124.22 ± 1.078 | 111.95 ± 1.027 |
| 45 | Right 2nd premolar | 128.97 ± 1.20 | 121.80 ± 1.022 |
| 35 | Left 2nd premolar | 128.44 ± 0.897 | 123.90 ± 1.017 |
| 46 | Right 1st molar | 79.99 ± 0.451 | 85.85 ± 0.984 |
| 36 | Left 1st molar | 79.99 ± 0.446 | 85.85 ± 0.984 |
| 47 | Right 2nd molar | 135.94 ± 1.77 | 138.8 ± 0.632 |
| 37 | Left 2nd molar | 135.80 ± 1.455 | 137.15 ± 0.608 |

**Table I (B).** Mean eruption time on maxilla

| Tooth Number | Tooth Name | Mean Eruption Time ± SD (months) | |
|---|---|---|---|
| | | Female | Male |
| 11 | Right Central Incisor | 87.02 ± 0.581 | 87.80 ± 0.907 |
| 21 | Left Central Incisor | 87.02 ± 0.587 | 87.80 ± 0.907 |
| 12 | Right Lateral Incisor | 105.57 ± 0.632 | 107.90 ± 1.193 |
| 22 | Left Lateral Incisor | 105.68 ± 0.43 | 107.60 ± 1.190 |
| 13 | Right Canine | 125.52 ± 0.933 | 128.85 ± 1.041 |
| 23 | Left Canine | 125.52 ± 1.204 | 129.55 ± 1.031 |
| 14 | Right 1st premolar | 85.07 ± 0.925 | 110.02 ± 1.046 |
| 24 | Left 1st premolar | 110.07 ± 0.987 | 111.95 ± 1.027 |
| 15 | Right 2nd premolar | 102.9 ± 0.937 | 121.80 ± 1.022 |
| 25 | Left 2nd premolar | 120.80 ± 1.243 | 123.90 ± 1.017 |
| 16 | Right 1st molar | 85.07 ± 1.308 | 85.85 ± 0.984 |
| 26 | Left 1st molar | 85.07 ± 0.367 | 85.85 ± 0.984 |
| 17 | Right 2nd molar | 137.77 ± 0.398 | 138.8 ± 0.632 |
| 27 | Left 2nd molar | 137.61 ± 1.371 | 137.15 ± 0.608 |

Both charts showed that the first molar is the first tooth that erupted, and the last tooth erupted is the second molar. It can be seen that the chronological sequence of teeth eruption is first molars, then central incisors, lateral incisors, first premolars, second premolars, canines, and the last are second molars. It can be concluded that generally, the mandibular and maxillary permanent teeth of girls erupted faster than boys.(Figure 1)



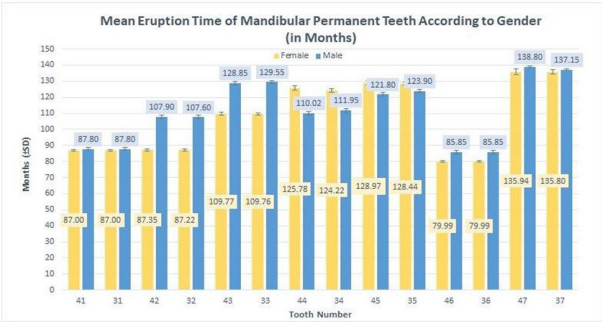




**Figure 1. Comparison of the mean eruption time of permanent teeth between genders A) maxilla, B) mandible.**

## DISCUSSION

IThe result Figure 1 (A and B) showed evidence of the hypothesis that permanent tooth eruption indicators can be used as a guide for determining age and gender in forensic odontology. This can be analyzed from the difference in the eruption age of each tooth, as well as the chronological age difference for the eruption of the teeth in boys and girls. In addition, from the presentation of figure 1 and 2, it is also known that in general, the eruption of teeth in girls is faster than boys(11). Tooth eruption is the movement of the tooth germ from a non-functional position to a functional position in the oral cavity during the alveolar process (12). This research evaluated the accuracy of clinical inspection of the eruption sequence of permanent teeth by checking whether the teeth had erupted or not.

The result charts showed that the eruption sequence of permanent maxillary teeth began from the first molar, then followed by central incisor, lateral incisor, first premolar, second premolar & canine, and the last teeth erupted was the second molar. The results of this study are the same as the results by Makino et al, 2018 which stated that the maxillary tooth which erupted first was the first molar (9).

Similar to the eruption sequence by Chaitanya in 2018, the result shows that in the mandible, the eruption of the permanent teeth began with the eruption of the first molar followed by the central incisor, meanwhile the result of Makino, 2018 reported that central incisors erupted first. Then the eruption occurred in the lateral incisors then continued by 1st premolar, 2nd premolar, and canine. The teeth erupted was second molar. It should be noted that in the mandible, there is a significant difference in eruption time in which girls experience lateral incisors eruption that is 18-20 months faster than males. Meanwhile, boys experienced premolar tooth eruption that was 6-12 months earlier than girls (9,13).

In general, it can be concluded that girls tend to erupt more rapidly than boys, even though the upper premolars of boys experience faster eruptions, even around 6-12 months. This is in accordance with research conducted by Makino et al in 2018 regarding the timing of tooth eruption based on gender, which found that there was a significant difference in the timing of tooth eruption, especially in the mandibular canine in girls than boys. In addition, other studies by the Japanese society of pediatric dentistry also showed that overall girls experienced more rapid eruption of teeth than boys, but this did not apply to maxillary 1st molars that was earlier in boys (9,14,17).

The differences in the timing of tooth eruptions can also be influenced by several other factors including nutrition, socioeconomic status, climate, and environmental factors, such as the fluoride content in drinking water can also affect tooth development in human embryos(15). The other nutrition that has a big effect on tooth eruption is vitamin D. Vitamin D regulates the absorption of calcium and phosphorus(16).

There is another factor that can affect the eruption times, the growth of the tooth root. The tooth will erupt when the length reaches two-thirds from the final length. If it is delayed, that will affect the delay of the eruption tooth. So that can be explained about the difference in both results of research about time of eruption tooth by the analytics there is a possibility of difference in growth development of the root of the tooth on the both research samples.

In general, the similarity in the sequence of tooth eruptions between the results of this study and the previous literature shows that the tooth eruption indicator has a high enough accuracy to be used as the basis for estimating the age and gender determination of the subject in the forensic field(13).

## CONCLUSION

Study of the growth pattern and development of permanent tooth eruption in children showed that the eruption of teeth in girls was faster than in boys. The result of this study can be used as an indicator of chronological estimation of age and sex determination of children with high accuracy. However, the timing and sequence of tooth eruptions can differ by race, social status, health patterns, and health care.

**ACKNOWLEDGEMENTS**

The research was financially supported by Directorate of Research and Community Service, Directorate General of Research and Development,Ministry of Research, Technology and Higher Education, Grant no. 018/SP2H/LT/DRPM/II2016.

**REFERENCES**

1. Reddy LV. Lip prints: An overview in forensic dentistry. Journal of Advanced Oral Research. 2011 Jan;2(1):17-20.
2. Koch G, Kreiborg S, Andreasen JO. Eruption and shedding of teeth. Pediatric Dentistry. A Clinical Approach. 3rd ed. Oxford: Wiley-Blackwell. 2017 Jan 4:40-54.
3. Khan N. Eruption time of permanent teeth in Pakistani children. Iranian journal of public health. 2011 Dec;40(4):63.
4. Azevedo AC, Michel-Crosato E, Biazevic MG, Galić I, Merelli V, De Luca S, Cameriere R. Accuracy and reliability of pulp/tooth area ratio in upper canines by peri-apical X-rays. Legal Medicine. 2014 Nov 1;16(6):337-43.
5. Cameriere R, Cunha E, Wasterlain SN, De Luca S, Sassaroli E, Pagliara F, Nuzzolese E, Cingolani M, Ferrante L. Age estimation by pulp/tooth ratio in lateral and central incisors by peri-apical X-ray. Journal of forensic and legal medicine. 2013 Jul 1;20(5):530-6.
6. Ge ZP, Ma RH, Li G, Zhang JZ, Ma XC. Age estimation based on pulp chamber volume of first molars from cone-beam computed tomography images. Forensic science international. 2015 Aug 1;253:133-e1.
7. Cameriere R, De Luca S, Alemбn I, Ferrante L, Cingolani M. Age estimation by pulp/tooth ratio in lower premolars by orthopantomography. Forensic science international. 2012 Jan 10;214(1-3):105-12.
8. De Souza N, Manju R, Hegde AM. Development and evaluation of new clinical methods of age estimation in children based on the eruption status of primary teeth. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2018 Apr 1;36(2):185.
9. Makino E, Tsujino K, Ishii T, Shintani S, Sueishi K. Difference in bilateral timing of eruption of permanent teeth. The Bulletin of Tokyo Dental College. 2018;59(4):277-84.
10. Oznurhan F, Ekci ES, Ozalp S, Deveci C, Delilbasi AE, Bani M, Oztas N. Time and sequence of eruption of permanent teeth in Ankara, Turkey. Pediatric dental journal. 2016 Apr 1;26(1):1-7.
11. Berger K, Eskenazi B, Kogut K, Parra K, Lustig RH, Greenspan LC, Holland N, Calafat AM, Ye X, Harley KG. Association of prenatal urinary concentrations of phthalates and bisphenol A and pubertal timing in boys and girls. Environmental health perspectives. 2018 Sep 11;126(9):097004.
12. Jain P, Rathee M. Anatomy, Head and Neck, Tooth Eruption. StatPearls [Internet]. 2020 Aug 10. https://www.ncbi.nlm.nih.gov/books/NBK549878
13. Chaitanya P, Reddy JS, Suhasini K, Chandrika IH, Praveen D. Time and eruption sequence of permanent teeth in Hyderabad children: a Descriptive cross-sectional study. International journal of clinical pediatric dentistry. 2018 Jul;11(4):330.
14. Nagasaka N. A transverse investigation into the immature permanent teeth of Japanese children: Degree of eruption, developmental disturbance of tooth structure, and the pattern of occlusion. Shoni Shikagaku Zasshi. 2000;38:1-3.
15. Kariya P, Tandon S, Singh S, Tewari N. Polymorphism in emergence of deciduous dentition: A cross-sectional study of Indian children. Journal of investigative and clinical dentistry. 2018 Feb;9(1):e12266.
16. Jairam LS, Konde S, Raj NS, Kumar NC. Vitamin D deficiency as an etiological factor in delayed eruption of primary teeth: A cross-sectional study. Journal of Indian Society of Pedodontics and Preventive Dentistry. 2020 Jul 1;38(3):211.
17. Soesilawati P, Notopuro H, Yuliati Y, Ariani MD, Firdauzy MA. The role of salivary sIgA as protection for dental caries activity in Indonesian children. Clinical, cosmetic and investigational dentistry. 2019;11:291.