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Research Report

Permanent tooth eruption based on chronological age and gender in 6-12-year old children on Madura

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ABSTRACT

Background: *Tooth eruption, the movement of teeth toward the oral cavity clinically marked by the emergence of the cusp or incisal edge, is very important in determining the chronological age of a child. Unfortunately, tooth eruption in 6-12-year olds on the island of Madura has yet to be investigated.* ***Purpose:*** *This study aimed to analyze differences in permanent tooth eruption between boys and girls aged 6 to 12 years old on Madura.* ***Methods:*** *This study employed an observational analytic design in combination with a cross-sectional approach. The samples used in this study were selected by means of simple random sampling technique. Post-selection informed consent of the child subjects was obtained with their chronological age being assessed and determined prior to tooth eruption. The normality of the data was subsequently analyzed by application of a one sample non-parametric Kolmogorov Smirnov test. Thereafter, repeated Anova tests were conducted to determine differences in the permanent tooth eruption of the subjects.* ***Results:*** *Based on the normality test results, the significance value of the permanent maxillary teeth in the male subjects was 0.993, while that of their permanent mandibular teeth was 0.695. In contrast, the significance value of the permanent maxillary teeth in the female subjects was 0.970, while that of their permanent mandibular teeth was 0.918. According to the results of the repeated measure ANOVA test, differences existed in the eruption of the permanent maxillary and mandibular teeth between the males and females with a significance value (ρ) of 0.020. The mean value of permanent mandibular tooth eruption in the females was 56.59 ± SD 33.403, while that of their permanent maxillary tooth eruption was 50.77 ± SD 34.201. The mean value of the permanent mandibular tooth eruption in the males was 55.31 ± 33.024, while that of their permanent maxillary tooth eruption was 48.77 ± SD 34.201.* ***Conclusion:*** *On Madura, the permanent teeth of chronological 6-12-year old females, particularly their permanent mandibular canine teeth, erupt earlier than those of their male counterparts.*

Keywords: *chronological age; permanent tooth eruption; sex*

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INTRODUCTION

Estimation of the age of an individual, conducted, for example, in the field of forensic odontology, is based on the sequence of tooth eruption within the oral cavity.[1] The eruption of human teeth is divided into three periods, namely: deciduous tooth eruption between the ages of 6 months and 6 years, mixed tooth eruption between the ages of 6 years and 12 years, and permanent tooth eruption between the age of 12 years and the point at which an individual loses all of his/her teeth.[1,2]

Forensic examination is conducted to estimate the chronological age of children for a variety of purposes, including: determining inheritance rights, child adoption cases, and crimes perpetrated against children.[3] Age estimation can be conducted by observing growth stages and body structure development in the form of consistent physical changes. Each stage of the developmental process can be directly related to age of an individual.[4]

The parts of the body usually analyzed to determine age are the skeleton and teeth. Unfortunately, skeletal maturity as a means of estimating age is subject to certain limitations

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since it can only predict age within a specific age range with a large standard deviation. Meanwhile, the use of teeth have several advantages as a means of age estimation, one of which is that it can predict age in individuals ranging from prenatal to adult.[5]

The accuracy of tooth-based age estimation depends on the selection of the method best suited to the circumstances of the individual case. Tooth-based age estimation generally employs a non-invasive method that involves clinical and radiographic examinations without resort to tooth extraction. The number of deciduous and permanent teeth that have erupted in children, adolescents or adults can be clinically examined employing a method of assessing the number of permanent teeth suitable for individuals between the age of 6 and adulthood.[5,6]

The number of erupted teeth indicates the maturity level of an individual. Thus, observing the number and condition of the teeth in the oral cavity can determine his/her age. This clinical observation involves no risk due to the absence of exposure to x-ray radiation.[7] Eruption is the process by which developing teeth move from the location of the tooth seed through the alveolar ridge into the oral cavity and experience occlusion with the antagonistic tooth. Eruption occurs if all clinical crowns are above the gingiva and the level is then calculated from the tooth cusp of the posterior teeth or from the incisal edge of the anterior teeth.[8]

The timing of the eruption of permanent teeth between the ages of 6 and 12 depending on the age and sex of the individual is also considered important for archeology and forensic studies involving human remains. Teeth have specific features useful in determining maturation which can predict the order of development, including: crown formation, roots, calcification, and eruption.[9]

The characteristics of distinct races, ethnic groups and populations differ, together with the timing of permanent tooth eruption.[10] The population of Indonesia is diverse, consisting of various ethnic groups including the Peutero and Deutero Malay sub-races. One such Deutero Malay sub-racial group is the Madurese who inhabit the island of Madura in the province of East Java and whose day-to-day life and dietary habits are both challenging.

To date, no research on permanent tooth eruption among the Madurese has been conducted. Consequently, this research aims to analyze the differing permanent tooth eruption of males and females chronologically aged 6-12 years on Madura.

MATERIALS AND METHODS

This study focused on differences in permanent tooth eruption between males and females chronologically aged 6-12 years on Madura and received ethical approval from the Health Research Ethics Commission, Faculty of Dentistry, Universitas Airlangga. It employed an analytic observational design with a cross-sectional approach. Samples of this study were selected by means of a simple random sampling technique. The criteria for the study sample comprised: healthy males and females aged between 6 and 12 classified as third-generation native-born Madurese based on their mothers/fathers/grandmothers/grandfathers all having been born on Madura. The subjects also had to be free of growth disorders, mental illness or congenital anomalies and did not suffer from dental caries or use orthodontia.

Tooth eruption measurement or scoring was subsequently conducted. If the tooth had not erupted, that is, it had not penetrated the gingiva with one part, with the entire incisal edge for incisors or with one or two cups for posterior teeth, its score would be 0. If the incisal edge or peak cups were visible, with a quarter of the anatomically crown erupted, a score of 0.25 was assigned. If half of the anatomical crown had erupted, the recorded score was 0.5. If more than half or almost all of the anatomically crown had erupted, its score would be 1.

The resulting data was analyzed using a non-parametric one sample Kolmogorov Smirnov test to determine its normality. A repeated measure Anova test was then performed in order to determine differences in tooth eruption between males and females with a significance value (α) of 0.05. (SPSS version 21).

RESULTS

The research samples comprised 117 children, 64 male and 53 female, aged between 6 and 12.99 years old. Moreover, based on the results of a normality test using a non-parametric one sample Kolmogorov Smirnov test, the significance value of the maxillary permanent teeth in the males was 0.993, while that of their mandibular permanent teeth was 0.695. In contrast, the significance value of the maxillary permanent teeth in the females chronologically aged 6-12 years was 0.970, while that of their mandibular

Table 1. The mean and standard deviation values of normality test and repeated measures ANOVA results

Tooth eruption	Mean	± SD	Kolmogorov Smirnov one sample test	Repeated measure ANOVA
Male maxilary tooth	48.68	33.608	0.993	0.02
Male mandibular tooth	55.31	33.024	0.695	
Female maxilary tooth	50.77	34.201	0.970	
Female mandibular tooth	56.59	33.403	0.918	

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Table 2. Permanent tooth eruption sequence in the males subjects based on average chronological age

Tooth	17	16	15	14	13	12	11	21	22	23	24	25	26	27
± SD	0.98	0.113	0.63	0.897	0.422	0.516	0.612	0.612	0.708	0.517	0.922	0.589	0.113	0.859
Mean	11.8	6.69	11	9.98	11.18	9.46	7.87	7.87	9.3	11.01	10.04	11.09	6.69	11.56
Mean	11.68	6.69	10.82	10.94	10.53	7.56	6.69	6.69	7.63	10.61	10.87	10.98	6.69	11.74
± SD	0.765	0.113	0.946	0.86	0.372	0.283	0.113	0.113	0.25	0.316	0.848	0.799	0.113	0.675
Tooth	47	46	45	44	43	42	41	31	32	33	34	35	36	37

Table 3. Permanent tooth eruption sequence in the female subjects based on average chronological age

Tooth	17	16	15	14	13	12	11	21	22	23	24	25	26	27
± SD	1.371	0.367	1.241	0.932	1.203	0.43	0.581	0.632	0.433	0.925	0.937	1.302	0.367	1.212
Mean	11.77	6.64	10.29	9.6	10.42	8.15	7.11	7.14	7.99	10.46	9.57	10.18	6.64	11.61
Mean	11.55	6.57	10.44	10.39	9.15	7.24	6.64	6.64	7.24	9.08	10.26	10.6	6.49	11.23
± SD	1.135	0.359	1.116	1.117	0.7	0.647	0.367	0.367	0.647	0.701	1.078	0.897	0.368	1.447
Tooth	47	46	45	44	43	42	41	31	32	33	34	35	36	37

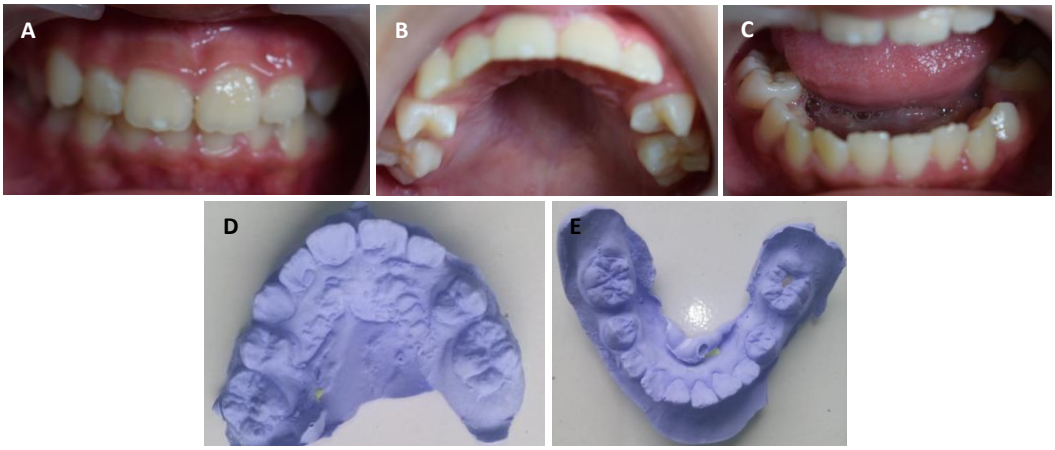

Figure 1. A) A female maxillary and mandibular chronologically aged 7.74 years old when occlusion occurred; B) A female maxillary; C) A female mandibular; D) A female maxillary cast result; E) A female mandibular cast result.

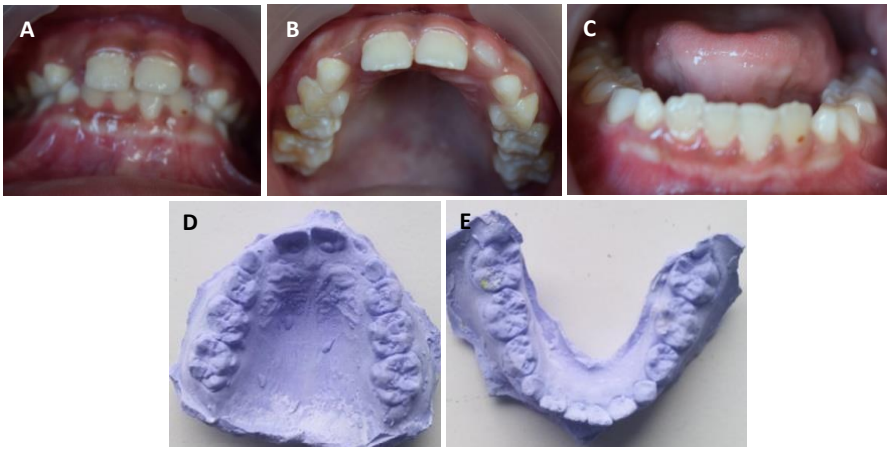

Figure 2. A) A male maxillary and mandibular chronologically aged 7.76-years-old when occlusion occurred; B) A male maxillary; C) A male mandibular; D) A male maxillary cast result; E) A male mandibular cast result.

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permanent teeth was 0.918. This signified differences in permanent tooth eruption between the males and females (Table 1).

The results of the repeated measure ANOVA test indicated differences in permanent tooth eruption between the male and female samples of the Madurese population with a significance value of 0.020 ($\rho<0.05$). Moreover, the order of tooth eruption in the mandibular canine teeth of the females differed significantly from that in the males. The order of tooth eruption in the males in terms of chronological age was 16, 26, 31, 36, 41, 46, 42, 32, 11, 21, 22, 12, 14, 24, 43, 33, 45, 34, 44, 35, 15, 23, 25, 13, 27, 47, 37, 17 (Table 2). Meanwhile, the tooth eruption sequence in the females based on chronological age was 46, 36, 16, 26, 31, 41, 11, 21, 32, 42, 22, 12, 43, 33, 24, 14, 25, 44, 15, 34, 13, 35, 23, 45, 47, 37, 27, 17 (Table 3).

In addition, the permanent maxillary and mandibular canine teeth of the females chronologically aged 7.74 years erupted more rapidly (Figure 1). Meanwhile, the permanent maxillary and mandibular canine teeth in the males chronologically aged 7.76 years had not yet erupted (Figure 2).

DISCUSSION

The results of this study revealed that the eruption of permanent teeth in the females of the Madurese population occurred earlier than in the males. Similarly, a study conducted at the Prof. Sudomo Oral and Dental Hospital of the Dentistry Faculty at Gadjah Mada University found that the maturation of permanent teeth in females was higher than in males.[11] Another previous study conducted in Surakarta also revealed that permanent tooth eruption in females occurs two months earlier than in males.[12] Similar to previous studies, one carried out in Lithuania found that permanent tooth eruption in females was more rapid than in males.[13]

However, the results of this study were not in line with those of one focusing on permanent tooth eruption in children aged 4-15 years in Kampala, Uganda. Generally, tooth eruption in females was found to more protracted than in males with the exception of teeth 25, 32 and 42, while the average tooth eruption between the two genders was known to differ by as much as 0.8 (with a range of 0-1.5 years).[14] Similarly, a study conducted in Karachi, Pakistan indicated there to be neither difference in tooth eruption between males and females, nor in tooth eruption compared to body weight and height.[10] Such findings are consistent with those of a study carried out in India showing that in the several populations studied, mandibular teeth erupted more rapidly than maxillary teeth, with a concomitant difference in tooth eruption time between the right and left regions of the maxilla and mandible.[15]

Eruption is the process within which developing teeth move from the location of the tooth seed through the alveolar ridge into the oral cavity, experiencing occlusion with the antagonistic tooth. Eruption occurs if all clinical crowns are above the gingiva with the level being calculated from the tooth cusp or the incisal edge. Tooth eruption occurrence varies in each child. Variations can even occur within each growth and development period of the teeth, being influenced by genetic and environmental factors.[9]

The contrasting findings of the above studies result from nutritional intake and status factors relating to children which largely determine tooth eruption. Moreover, permanent tooth eruption time varies more than that of its deciduous counterpart.[13] Differences in permanent tooth eruption time in several regions are influenced by numerous factors, including; genetic and environmental factors involving socioeconomic and nutritional status, as well as climate. It is also known that permanent tooth eruption time varies between racial groups.[10]

Tooth eruption is influenced by several factors such as socioeconomic, nutrition, sex, race, hormonal and genetic factors.[13] Socio-economic conditions represent one of the factors affecting tooth eruption. However, a study conducted in Brazil posited that, in fact, no correlation exists.[16] It has also been argued that there is no relationship between nutritional status and anthropometric measurements, such as height and weight, in addition to tooth eruption.[14] The above statement accords with the 2015 assertion of the Pasongsongan Public Health Center in the Sumenep Regency that the environmental conditions found in the coastal Pasongsongan region of Sumenep Regency where the majority of residents are fishermen, were such that nutrient intake, especially protein and calcium, was extremely abundant.

Eruption of permanent teeth is of considerable significance. In addition to determining the age of a person, it can also support certain diagnoses, for example, massive hard tooth tissue damage, since teeth are resistant to environmental changes and post-mortem decomposition and can be maintained without distortion. Just as with fingerprints, the morphology and arrangement of teeth is unique to each individual and are, therefore, extremely helpful in identifying a specific individual.[17]

Normal standards must be applied to the clinical assessment of the growth of a child in order that the physiological age of the tissue system can be compared with its chronological age.[18] Despite being of the same chronological age, children can present different stages of biological development and the dental care of those who still have mixed teeth requires special attention. Therefore, it is essential for a pediatric dentist to have knowledge about the growth of a child, particularly the development of teeth and its variations.[19]

Tooth eruption is frequently analyzed forensically in order to estimate the age of a child and to assess dental maturation or clinical age. Dental age is used by dentists to determine the appropriate timing of certain orthodontic treatments, including that for deciduous teeth. Establishing dental age can be conducted in two ways, namely; examining the status of those teeth that have erupted in the

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oral cavity, or clinical methods such as non-x-ray methods considered to be more practical and involving no use of radiation on patients.[6,20]

The effects of tooth eruption and the number of abnormalities that may be caused by resulting disorders in the oral cavity should enhance the awareness of dentists regarding the precise timing of tooth eruption. Such knowledge is important for dentists, especially those active in the fields of pedodontics and orthodontics, in helping to determine diagnosis and the appropriate type of treatment. Finally, it can be concluded that the permanent teeth of females within the population of Madura chronologically aged 6-12 years erupt earlier than those of males. The earliest eruption occurs in the permanent mandibular canine teeth of females.

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