



Permanent Teeth Eruption Status in Growing-Age Children with Normal Nutritional Status Based on Gender

Atiek Driana Rahmawati¹(✉), Siti Rahayu², Ana Medawati³, Likky Tiara Alphianti¹,
Nabila Nurushifa Latiefiana^{1,2,3}, and Widya Ranasti^{1,2,3}

¹ Faculty of Medicine and Health Sciences, Department of Pediatric Dentistry, Dental School,
Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia
atiek.driana@umy.ac.id

² Dental Polyclinic, PKU Gamping General Hospital, Yogyakarta, Indonesia

³ Faculty of Medicine and Health Sciences Departement of Biomedical Science, Dental School,
Universitas Muhammadiyah Yogyakarta, Yogyakarta, Indonesia

Abstract. Introduction – The order of tooth eruption is essential in determining the diagnosis and treatment for dentistry. One of the elements affecting tooth eruption is gender. In this regard, the pubertal growth spurt in boys is half to two years later than in girls. **Aims** – This study aims to examine the permanent teeth eruption status in children with normal nutritional status based on gender. **Methods** – This cross-sectional study involved 164 boys and girls as subjects, including 82 aged 6–7 years and 82 aged 10–11 years, and then the jaws were cast on them. The permanent teeth eruption status was determined by scoring each tooth (0 = not yet erupted, 1 = partially erupted, and 2 = fully erupted). Children aged 6–7 years old had their teeth 16, 26, 36, 46, 31, and 41 scored, while children aged 10–11 years old had their teeth 14, 15, 24, 25, 34, 35, 44, 45 scored. Mann-Whitney test was then employed to evaluate the difference in eruption status between boys and girls. **Findings** – The p-value = 0.01 in tooth 16; p = 0.029 (26); p = 0.000 (36); p = 0.000 (46); p-values for 31, 41, 14, 24, 15, 25, 34, 44, 35, and 45 were > 0.05. It indicates that the eruption status of teeth 16, 26, 36, and 46 differed significantly between boys and girls but not for teeth 26, 31, 41, 14, 24, 15, 25, 34, 44, 35, and 45. **Implication** – This study can be utilized to guide dental treatment decisions, particularly orthodontic therapy, based on the patient's gender.

Keywords: Eruption status · Permanent teeth · Gender · Growing age

1 Introduction

Tooth eruption is one of several processes involved in tooth development [1]. As such, dental treatment planning requires careful consideration of the timing and order of tooth eruption [2]. In this respect, age-related tooth eruption takes place in each individual. The maxillary and mandibular first molars, as well as the mandibular central incisors, begin to erupt at the age of 6–7; the maxillary central incisors and mandibular lateral

incisors start to erupt at the age of 7–8 [3]. Meanwhile, the maxillary lateral incisors erupt at the age of 8–9 years, and the mandibular canines erupt at the age of 9–10 years. In addition, the maxillary and mandibular first premolars, maxillary second premolars, maxillary canines, and mandibular second premolars all erupt between the ages of 10 and 12. Then, the maxillary and mandibular second molars erupt between the ages of 11 and 13; the third molars erupt between the ages of 17 and 21 [4].

In this case, permanent teeth frequently erupt later than expected, hindering their development. Consequently, a variety of dental and oral anomalies can result from delayed teeth eruption [5]. Gender, genetics, nutrition, illness, environment, socioeconomic status, and congenital anomalies are among the factors influencing tooth eruption [6]. Specifically, according to Sindelárová et al.'s research, gender is one of the elements affecting tooth eruption [7]. Related to that, a growth spurt is a sudden increase in a person's height and weight that happens during puberty as a result of the simultaneous release of androgens, thyroid hormones, and growth hormones. Different children experience different pubertal growth spurts; in boys, the phase of development acceleration occurs half a year to two years later than in girls. In addition, the average age range for reaching puberty is between 9 and 14 years for girls and between 10 and 17 years for boys. Some boys continue growing even into their 20s [8]. In this study, boys and girls with normal nutritional status had their permanent teeth examined to see how they erupted. The determination of nutritional status in this study then used body mass index for age (BMI/Age).

2 Material and Method

This analytic study used a cross-sectional design. Students from Muhammadiyah Purwodiningratan Elementary School in Yogyakarta served as the research subjects. The screening was carried out on all elementary school students where the research was conducted whose parents had given informed consent. As many as 162 research subjects consisted of boys and girls aged 6–7 years and 10–11 years old. Then, this study's subjects were measured for height and weight to determine their nutritional status. Subjects with normal nutritional status were then performed on the upper and lower jaws to score the eruption status by observing the results of the prints. Here, score 0 indicates the absence of teeth in the oral cavity; 1 denotes a partially erupted tooth that is not yet in touch with the opposing tooth at the occlusal plane; 2 signifies a completely erupted tooth that has reached the occlusal plane. In this study, teeth 16, 26, 36, 46, 14, 15, 24, 25, 34, 35, 44, and 45 were used. The data were then analyzed to determine the eruption status of boys and girls and the differences between them.

3 Result

This study was based on the evaluation of the dental eruption status scores obtained from dental impressions taken of 164 children between the ages of 6–7 and 10–11 each of whom had 82 children, including both boys and girls (Tables 1, 2 and 3).

The Mann-Whitney test results in Table 4 show the p -value < 0.05 on teeth 16, 26, 36, and 46, meaning that there was a significant difference in the eruption status of these

Table 1. Characteristics of research subjects

Age (years old)	Gender		Total
	Boys	Girls	
6–7	41	41	82
10–11	41	41	82
Total	82	82	164

Table 2. Eruption status of children aged 6–7 years

Gender	Tooth element	Tooth eruption status						
		0		1		2		Total
		N	%	N	%	N	%	%
Girls	16	5	12.2	19	46.3	17	41,5	100
	26	5	12.2	19	46.3	17	41,5	100
	36	3	7.3	10	24.4	28	68,3	100
	46	3	7.3	10	24.4	28	68,3	100
	31	5	12.2	9	22	27	65,9	100
	16	5	12.2	19	46.3	17	41,5	100
Boys	16	13	31.7	20	48.8	8	19,5	100
	26	11	26.8	21	51.2	9	22	100
	36	9	22	21	51.2	11	26,8	100
	46	9	22	21	51.2	11	26,8	100
	31	15	36	4	9.8	22	53,7	100
	41	14	34.1	5	12.2	22	53,7	100

teeth between boys and girls aged 6–7 years. Different results were also shown in teeth 31 and 41, with a significance value of 0.090 ($p > 0.05$) in teeth 31 and 0.143 ($p > 0.05$) in tooth 41. It indicates that there was no difference in the eruption status of these teeth between boys and girls aged 6–7 years.

In addition, the Mann-Whitney test results in Table 4 reveal that the p-value was < 0.05 on teeth 16, 26, 36, and 46. It denotes that there was a significant difference in the eruption status of these teeth between boys and girls aged 6–7 years. Moreover, different results were displayed in teeth 31 and 41, with a significance value of 0.090 ($p > 0.05$) in teeth 31 and 0.143 ($p > 0.05$) in tooth 41. It signifies that there was no difference in the eruption status of these teeth between boys and girls aged 6–7 years.

In Table 5, the Mann-Whitney test results uncover that the significance of the eruption status of teeth 14, 24, 15, 25, 44, 34, 45, and 35 was greater than 0.05. It suggests that there was no difference in the eruption status of these teeth between boys and girls.

Table 3. Eruption status of children aged 10–11 years

Gender	Tooth element	Tooth eruption status						
		0		1		2		Total
		N	%	N	%	N	%	%
Girls	14	10	24.4	9	22	22	53.7	100
	24	7	17.1	11	26.8	23	56.1	100
	15	23	56.1	4	9.8	14	34.1	100
	25	21	51.2	6	14.6	14	34.1	100
	34	9	22	11	26.8	21	51.2	100
	44	10	24.4	12	29.3	19	46.3	100
	35	21	51.2	8	19.5	12	29.3	100
	45	24	60	6	15	10	25	100
Boys	14	8	19.5	8	19.5	25	61	100
	24	7	17.1	8	19.5	26	63.4	100
	15	24	58.5	6	14.6	11	26.8	100
	25	22	53.7	7	17.1	12	29.3	100
	34	9	22	8	19.5	24	58.5	100
	44	12	29.3	7	17.1	22	53.7	100
	35	21	51.2	4	9.8	16	39	100
	45	23	56.1	4	9.8	14	34.1	100

Table 4. Results of different eruption status tests between boys and girls aged 6–7 years

	ES_16	ES_26	ES_31	ES_41	ES_36	ES_46
Mann-Whitney U	582.500	624.500	680.500	701.000	478.500	478.500
Wilcoxon W	1443.500	1485.500	1541.500	1562.000	1339.500	1339.500
Z	-2.590	-2.180	-1.693	-1.464	-3.673	-3.673
Asymp. Sig. (2-tailed)	0.010	0.029	0.090	0.143	0.000	0.000

Grouping Variable: Gender

4 Discussion

This study was conducted on the differences in the eruption status of the maxillary and mandibular first molars and the mandibular permanent central incisors between boys and girls aged 6–7 years and 10–11 years. The data analysis results showed $p < 0.05$ on teeth 16, 26, 36, and 46. It indicates that there were differences in the eruption status of all the first molars in both the upper and lower jaws between boys and girls. The existence of differences in eruption status in this study is similar to the study of Eskeli

Table 5. Results of different eruption status tests between boys and girls aged 10–11 years

	ES_14	ES_24	ES_15	ES_25	ES_34	ES_44	ES_35	ES_45
Mann-Whitney U	775	789.5	800	807	792.5	816	800,5	766
Wilcoxon W	1636	1650	1661	1668	1653,5	1677	1661,5	1586
Z	-0.682	-0.539	-0.425	-0.343	-0.494	-0.247	-0.0409	-0.579
Asymp. Sig. (2-tailed)	0.495	0.590	0.671	0.732	0.621	0.805	0.683	0.563

Grouping Variable: Gender

et al. in Finland, reporting that there were differences in the status of tooth eruption in boys and girls. In addition, the first and second phases of mixed dentition in girls erupted earlier than in boys [9]. It also aligns with a study conducted by Marjianto et al., stating that there were differences in the eruption status of permanent teeth in male and female samples in Madura at the age of 6–12 years. The results showed that permanent tooth eruption in women occurred more quickly when compared to men [10].

The difference in eruption status between boys and girls is related to the stage of calcification. The calcification stage is the early stage as the initial level of the estimated time of growth acceleration between males and females are the same, but in females, root formation and apical closure occur earlier, leading to accelerated eruptions. Compared to men, women also experience earlier dental and skeletal growth. In addition, early growth in girls is related to progress in their physical and biological development [11].

Differences in the teeth eruption of boys and girls are also related to the onset of maturation. In females, tooth eruption that occurs earlier is associated with the onset of maturation. In this case, chronological age with tooth eruption and tooth maturation has a close relationship. Here, one of the methods in assessing tooth maturation often used is the Dermijian method, which has relatively high reliability; it only uses eight developmental stages and has very detailed description criteria by using the relative lengths of the tooth crown and tooth root [12]. Moreover, the earlier onset of maturation in girls is related to hormonal factors. Progesterone and estrogen hormones will affect the growth and development of both men and women. The hormone will undergo a process until there is a functional maturity called the signs of puberty. Puberty in girls occurs earlier than puberty in boys [13]. Estrogen can also increase the amount of the protein matrix. A large amount of protein matrix will affect the mineralization of teeth so that the dentin formation process occurs more quickly [14]. An increase in the production of this hormone can then affect the process of root dentin formation so that it occurs more quickly and will affect the time of tooth eruption [15].

In this study, the difference in eruption status of the mandibular permanent central incisors between boys and girls aged 6–7 years did not give significant results. This result is consistent with a study by Kuswandari, which showed that there was no significant difference between the eruption of permanent teeth in boys and girls. Research by Raj et al. in India also stated that there was no significant difference in tooth eruption in males and females in both jaws and regions. The absence of a difference in tooth eruption might

be due to the premature loss of primary teeth in boys so that the eruption of permanent teeth can occur earlier or on a par with girls; thus, there is no difference in the time of tooth eruption [16]. Premature loss of deciduous teeth can also occur due to extraction of teeth because of severe caries so that early eruption can occur [17]. In this regard, caries is the main etiology of premature loss of primary teeth followed by trauma. Permanent teeth, which erupt too early even though less than fifty percent of the teeth roots are formed, can occur because the previous primary teeth had severe caries so that the coronal bone of the permanent teeth was damaged; it eventually results in early permanent tooth eruption or what is known as premature eruption [12]. Besides, the wide individual variation in chronological age and the eruption of teeth also make the mean age of tooth eruption not reliable to predict.

Apart from premature loss, delayed tooth eruption, or called delayed tooth eruption, in either sex can cause permanent teeth to appear at the wrong time so that there is no difference in the eruption of permanent teeth. Delayed tooth eruption occurs if the tooth eruption is two years later than the expected time. Delayed eruption of permanent teeth can then result in malocclusion and impaired mastication. If the anterior teeth experience delayed tooth eruption, the aesthetic function will be lost and will affect the child's psychology. Delayed eruption of permanent teeth can also cause delays in orthodontic treatment since they have to wait for the eruption of permanent teeth. The greatest delay in tooth eruption was found in children aged 6 years, while in children aged 9 years and over, there was no difference in eruption time [18]. It signifies that in this study, there was a possibility of delayed tooth eruption in subjects aged 6–7 years in teeth 31 and 41. The Mann-Whitney test also revealed no significant difference in the eruption status of teeth 14, 24, 15, 25, 34, 44, 35, and 45 between boys and girls aged 10–11 years. These findings support Jurca's study, which found no discernible difference between teeth eruption in the group of boys and girls aged 10–11 years, but significant differences were uncovered in the group of girls aged 6–7 years and boys' group 12–13 years [19]. It is because the process of formation and development of teeth at this calcification stage takes precedence over the stage of tooth eruption. After all, this calcification stage is continuous, while the eruption of these teeth occurs more quickly, and the time is very difficult to predict or determine.

This varied eruption time can be caused by genetics, socioeconomic, and nutrition. Particularly, genetic factors have a leading role in determining the time of permanent tooth eruption. The phenotype that affects tooth eruption is secreted by genes in tooth eruption, i.e., the parathyroid hormone-related protein (PTHrP) gene; in this case, middle socioeconomic status has faster teeth eruption because it is also related to nutritional intake and tends to have good nutrition compared to low economic status [20]. In this study, subjects with normal nutritional status in boys and girls aged 10–11 years were involved. This study showed that the subject's school environment and habits of consuming nutritious food were similar, so the time of tooth eruption in boys and girls at that age was the same. Here, the environment has an important role in the development of children, such as the social environment and how their relationships with family, peers, and other people; if the environment formed is good, these children can have the same level of growth and development between boys and girls [21].

Furthermore, the growth spurt phase occurs during the mixed dentition phase, which happens around the age of 7–11 years. A study by Margaretha also involved boys and girls aged 10–11 years as subjects. It was revealed that children at this age enter the growth spurt phase and the mixed dentition phase. Additionally, at this age, both boys and girls reach the prepubertal stage, during which there is no physical difference in growth and development generally, and the average rate of tooth eruption is the same for both sexes [22]. In addition, the prepubertal phase, which lasts from 10 to 13 years, is a stage between childhood and adolescence [23]. Throughout puberty, gametogenesis matures and gonadal hormones are then secreted, which are a complicated set of biological changes influenced by genetic, hormonal, and environmental factors. The puberty phase is also accompanied by changes in cognition, psychology, and social behavior [24]. Besides, premolar eruption patterns or frequencies are the same for both boys and girls during the prepubertal phase; however, with puberty, premolar eruption patterns change until the teeth are completely occluded in the oral cavity [25].

5 Conclusion

Based on this study's findings, it can be concluded that the eruption status of the right permanent first molar and left permanent first molar for both upper and lower jaws varied. In addition, boys and girls aged 6–7 years old did not differ in their eruption status of the mandibular right central incisor and the mandibular left permanent central incisor. Meanwhile, for both boys and girls, premolar eruption status was the same at the age of 10–11 years.

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