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Research paper

The eruption phase of second permanent molar in children aged 11-15 years in coastal area of pugerIndonesia

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Abstract

Background : The first permanent teeth that erupt in the oral cavity is the first permanent molar, which has a high risk of extraction due to caries. Functionally, permanent second molars can replace the function of permanent first molars. Permanent second molars erupt at the age of 11-15 years. The eruption of teeth can be influenced by environmental factors. One of the environmental factors is the geographical conditions. Geographical conditions, such as in coastal areas, will affect the economic conditions and consumption patterns of people living in the area, so it is possible that this can affect tooth eruption. Aims and Objectives : This study aimed to examine the eruption phase of the second permanent molar in children aged 11-15 in the coastal Puger district, Jember. Study Design : This study is a descriptive observational study with a cross-sectional approach. Materials and Methods: The sample was 100 pairs of study models of children aged 11-15 years who lived on the coastal area of Puger. Results : Observed eruption phase of permanent second molars in maxillary and mandibular study models and classified into four phases: 0.00 = tooth not erupted, 0.25 = cusp erupted until quarter of the height of the tooth is erupted, 0.50 = half of the height of the tooth is erupted, 1.00 = tooth has more than half until the whole clinical crown erupted. Conclusion : The results showed that the children on the Puger coast had a faster eruption time, in addition, the mandibular teeth erupted earlier than the maxillary teeth and needed 3 years to reach full eruption.

Keywords: *Tooth Eruption;Permanent Second Molar;Coastal Area.*

1. Introduction

Tooth eruption is a natural physiological mechanism by which the teeth sequentially cut through the gingiva into the oral cavity.[1] Eruption is the mechanism of growth responsible for bringing a tooth from its crypt location via the alveolar process into the oral cavity to its final occlusion position with its antagonist, a complex process requiring the completion of root development and periodontium establishment and the preservation of a functional occlusion.[2] This local process is regulated by genes expressing in the dental follicle, at critical periods following a precise chronology, bilaterally coordinated with facial growth.[3]

Unlike the third molars, in first and second permanent molars eruption abnormalities are relatively rare, estimated at 0.06% by Prece and Grover reported similar prevalence, at 0.08% for second maxillary molars and 0.01% for first mandibular molars.[3] More recently, considerably higher prevalence rates were reported in retrospective studies based on orthodontic consultation records: 2.3% for second molar eruption abnormalities as a whole, comprising 1.5% ectopic eruption, 0.2% impaction and 0.6% primary failure of eruption (PFE), and up to 1.36% permanent second molar iimpaction according to Cassetta et al.[4] Second molar retention is generally discovered serendipitously, being asymptomatic in 68.5% of cases.[5]

The eruption sequence, influenced by several local and systemic causes, may be delayed or accelerated. While permanent teeth eruption is under important genetic control, this process can be affected by numerous general factors such as sex, socioeconomic status, craniofacial morphology, body composition and metabolic disorders.[6] Delayed tooth eruption is a recorded consequence of childhood hypothyroidism, a disorder developed when the thyroid, a major regulator of metabolism, is underactive.[7] Conversely, earlier eruption of permanent teeth has been observed in overweight and obese children and those with diabetes mellitus.[8] Early eruption of permanent teeth could be for premature loss of primary teeth if the loss occurs within one year before eruption. But if the extraction is done at a very young age, the eruption of teeth is delayed.[9] Delayed eruption is associated with local and systemic factors such as mucosal barriers-scar tissue including trauma, surgery, supernumerary teeth, injuries to primary teeth, ankyloses as local factors and nutrition: Vitamin D-resistant rickets, celiac disease, hypothyroidism (cretinism), hypopituitarism as systemic factors.[6]

People living in the coastal areas of Puger usually have a low socioeconomic level due to the uncertainty of fishing.[10] Children raised in families with low socioeconomic levels tend to have slower eruption times than children with high socioeconomic levels.[11] This is not in accordance with Koenela's research, which found that the teeth of children living in coastal areas tended to erupt faster. In addition, the water used for domestic purposes in the coastal area of Puger has a high calcium and magnesium content.[12] This may affect the eruption time of the teeth.

The first permanent tooth that erupts in the oral cavity is the first permanent molar, which has a high risk of extraction due to caries.[6] Mandibular second molar normally erupts in girls from the age of 8 years and 11 months to 14 years and 4 months (mean 11.3 years).

Meanwhile, in boys this is from 9 years and 11 months to 13 years and 11 months (mean 12.0 years) with root completion at 14-15 years.[13] Functionally, the second permanent molar can replace the function of the first permanent molar. The second permanent molar erupts between the ages of 11 and 15.[11] This study aimed toexamine the eruption phase of the second permanent molar in children aged 11-15 in the coastal Puger district, Jember.

2. Materials and methods

This study was an observational descriptive research with a cross-sectional approach, conducted from January to March 2023 at the Oral Biology Laboratory of the Faculty of Dentistry, Jember University. The sample of this study was study models of children aged 11 to 15 years living in the coastal area. The criteria of the sample included the well-imprinted anatomical landmarks of the second permanent molars and the surrounding tissues, and the the crowns of the permanent second molars were intact.

The sampling technique used was purposive sampling, resulting in a sample of 100 pairs of study models, consisting of 100 maxillary study models and 100 mandibular study models. This resulted in a total of 200 maxillary second molars and 200 mandibular second molars.

The research procedure consisted of observing the eruption status of the second permanent molars in the maxillary and mandibular study models based on the eruption phases and recording the observations on the provided observation form. The observations were categorized into four phases as follows: 0.00 = tooth not erupted, 0.25 = cusp erupted until quarter of the height of the tooth is erupted, 0.50 = half of the height of the tooth is erupted, 1.00 = tooth has more than half until the whole clinical crown erupted.[10]

Ethicalconsiderations

Written, informedconsentwas obtainedfrom each studyparticipant. Participants were informed about the objectivesof the study and the confidential and non-binding nature ofparticipationinthestudy.Ethical approval for this study (No.1863/UN25.8/KEPK/DL/2023) was provided by the Ethical Committee of Medical Research. The research was conducted at the Faculty of Dentistry, Jember University, Jember, on January 27, 2023.

3. Results

Table 1: Eruption Phase of Permanent Second Molar in Maxillary Study Model

Age	Eruption Phases Tooth not erupted	Cusp erupted	Half erupted	Full eruption	n
11	5 (83,3%)	1 (16,4%)	0	0	6 (100%)
12	10 (20,8%)	26 (54,2%)	12 (25,0%)	0	48 (100%)
13	5 (5,1%)	20 (20,4%)	56 (57,2%)	17 (17,3%)	98 (100%)
14	0	0	14 (31,8%)	30 (68,2%)	44 (100%)
15	0	0	1 (25,0%)	3 (75,0%%)	4 (100%)
Total	20	47	83	50	200 (100%)

Table 1 shows that at the age of 11 years on the maxillary study model, the largest percentage of the eruption phase is in the tooth not erupted phase (83.3%), but there is 1 tooth in the cusp erupted phase (16.4%). The largest total percentage of eruption phases at age 12 years was in the cusp erupted phase at 54.2%. The largest percentage of eruption phases at age 13 years was in the half erupted phase with 57.2%. The largest percentage of eruption phases at age 14 was in the full eruption phase at 68.2%. The largest percentage of the eruption phase at age 15 was in the full eruption phase at 75.0%.

Table 2: Eruption Phase of Permanent Second Molar in Mandibular Study Model

Age	Eruption Phases Tooth not erupted	Cusp erupted	Half erupted	Full eruption	n
11	2 (33,3%)	4 (66,7%)	0	0	6 (100%)
12	4 (8,3%)	15 (31,3%)	29 (60,4%)	0	48 (100%)
13	0	10 (10,2%)	24 (24,5%)	64 (65,3%)	98 (100%)
14	0	0	10 (22,7%)	34 (77,3%)	44(100%)
15	0	0	1 (25,0%)	3 (75,0%)	4 (100%)
Total	6	29	64	101	200 (100%)

Table 2 shows that at age 11, the largest percentage of the eruption phase in the mandibular study model was in the cusp erupted phase at 66.7%. The largest percentage of the eruption phase at age 12 was in the half erupted phase at 60.4%. The largest percentage of eruption phases at age 13 was in the full eruption phase at 65.3%. The largest percentage of eruption phases at age 14 was in the full eruption phase at 77.3%. The largest percentage of eruption phases at age 15 was in the full eruption phase at 75.0%.

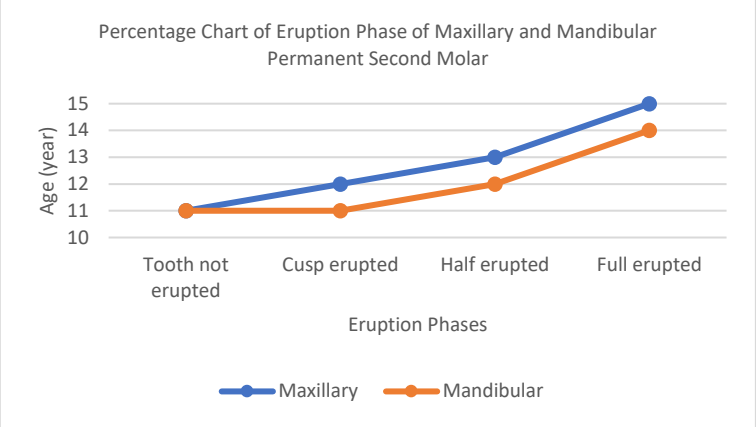

Fig. 1: Percentage Chart of Eruption Phase of Maxillary and Mandibular Permanent Second Molar.

Figure 1 shows that the mandibular eruption is earlier than the maxillary eruption. This can be seen in the cusp erupted phase, which in the mandible at 11 years of age and in the maxilla at 12 years of age. In addition, Figure 1 shows that the mandible has a full eruption earlier than the maxilla. This is shown in the full eruption phase, the mandible is at the age of 14 years, while the maxillary is at the age of 15 years. Figure 1 also shows that the age difference between the cusp erupted phase and the full eruption phase is 3 years.

4. Discussion

Based on Table 1, the most common eruption phase observed in the maxillary study models at age 11 was the tooth not erupted phase. However, there was one tooth that was in the cusp erupted phase. This finding contradicts the research conducted by Anggraini et al [14], which stated that the second maxillary permanent molars erupt between 12-13 years of age. In addition, Table 2 shows that at the age of 13, the teeth in the mandibular study models were in the full eruption phase. This finding does not accord with Primasari's statementthat the age range for full eruption of the second permanent molars in the mandibular is 14-15 years.[15] This occurrence of early eruption in children may be influenced by environmental factors.[16]

Environmental factors include socio-economic, socio-cultural, and nutritional factors that may influence children's growth and development, including tooth eruption. This study was conducted using study models of children aged 11-15 years living in the coastal area of Puger. The majority of the population depends on fishing and fish trade for their income. Based on the research conducted by Arif et al [17], the unpredictable income of fishermen and the low level of education in the coastal area of Puger lead to a situation where the coastal population mainly depends on fishing and fish trade to meet their daily needs, making fishing a cultural practice in the coastal people. The geographical location may also influence the food pattern of the population, with coastal populations more likely to consume fish and other seafood.[18]

Fish meat consumed by the Puger population is rich in macronutrients and micronutrients essential for humans, including protein, calcium, phosphorus, iron, magnesium, iodine, zinc, vitamin D, and other minerals essential for tooth growth and development.[19] This is in accordance with research conducted by Koenela et al [10], who found that dental eruption tends to occur earlier in coastal areas compared to mountain regions, mainly due to the high consumption of fish by coastal people.

Protein is one of the macronutrients found in fish. Protein is an essential nutrient in the growth process of each cell layer in the developing tooth and is also required for the formation of the tooth matrix. Protein deficiency during tooth growth and development can result in delayed eruption of permanent teeth.[20] In addition to protein, other nutrients found in fish that are needed during the process of tooth growth include calcium and phosphorus. Calcium and phosphorus are needed in the process of tooth calcification, where in the calcification process there is a deposition of matrix and calcium salts, so the calcification process becomes faster and will accelerate the time of tooth eruption.[21] This is confirmed by the research of Jasmine et al [22], which states that conditions of calcium and phosphorus deficiency for a long period of time can cause a delay in the eruption of permanent teeth.

Other than fish, the calcium obtained by the coastal community of Puger also comes from the water used to meet their domestic needs. The Puger coastal area has a medium to hard water hardness level, where water hardness is a chemical condition of the water that has a high calcium and magnesium content. Water generally has a hardness level of less than 50 mg/l, but water with medium hardness has a content of 50-150 mg/l, and water with hard hardness has a content of 150-300 mg/l. Water with this level of hardness is used by the community to meet their domestic needs.[11]Calcium and phosphorus levels in the body are closely related to the presence of vitamin D. The function of vitamin D is to absorb and regulate calcium and phosphorus in the body. The presence of vitamin D deficiency results in incomplete calcification due to inadequate absorption of calcium and phosphorus, causing a delay in tooth eruption.[23] This statement is in accordance with the research conducted by Jasmine et al [22], which states that in children with good nutritional status, the appearance of their teeth is faster than in children with poor nutritional status.

Based on the results of the study, it was also found that the second molar teeth in the mandibular erupted earlier than the maxillary, this can be seen in Figure 1 which shows that the percentage of the full eruption phase is highest in the mandibular, in addition, it can be seen in Table 1 and Table 2 at the age of 11 years, the percentage of the cusp erupted phase has been seen to be greater in the mandibular compared to the maxillary. This is in accordance with the statement of Wangidjaja[24] and Anggraini et al.[14] that during the eruption period, the teeth in the mandibular erupt earlier than the teeth in the maxillary. Based on Figure 1, also shows that the age difference between the cusp erupted phase and the full eruption phase is 3 years. This is consistent with Primasari's statement that permanent teeth take 3 years after eruption to reach full eruption.[15] Suggestions for further research need to be conducted similar research in areas with different geographical conditions in Indonesia as a comparison of the eruption of second permanen molar teeth in the coastal area.

5. Conclusion

Based on the results of the studies conducted, it can be concluded that both in the maxillary and mandibular second molar was the full eruption phase at the age of 14 years.

Conflict of interest

The authors have no conflicts of interest to declare.

Author contribution

NP and SM contributed as inventors and data collectors; BP contributed as data analyzers and translators; S, RB and DS contributed as data processors.

References

[1] Neto PG, Falcão MC. Eruption chronology of the first deciduous teeth in children born prematurely with birth weight less than 1500 g. Rev Paul Pediatr. 2014;32(1):17-23. https://doi.org/10.1590/S0103-05822014000100004.

[2] Palanisamy V, Rao A, Shenoy R, Baranya SS. Correlation of dental age, skeletal age, and chronological age among children aged 9-14 years: a retrospective study. J Indian Soc Pedod Prev Dent. 2016;34(4):310-4. https://doi.org/10.4103/0970-4388.191408.

[3] Cohen-Lévy, J and Cohen, N. Eruption abnormalities in permanent molars: differential diagnosis and radiographic exploration. J Dentofacial Anom Orthod. 2015;18:403https://doi.org/10.1051/odfen/2014054.

[4] Cassetta M, Altieri F, Di Mambro A, Galluccio G, Barbato E. Impaction of permanent mandibular second molar: a retrospective study. Med Oral Patol Oral Cir Bucal. 2013;18(4):e564-8https://doi.org/10.4317/medoral.18869.

[5] Guiral-Desnoës, H. Local and systemic permanent second molar eruption pathology: diagnostic and therapeutic decision trees. J Dentofacial Anom Orthod. 2015;18:404https://doi.org/10.1051/odfen/2015018.

[6] Kamali Sabeti A, Entezari Moghaddam N, Younesi G. The rare eruption of second mandibular permanent molar in a seven-year-old girl: a case report. Avicenna J Dent Res. 2021;13(2):72-75. https://doi.org/10.34172/ajdr.2021.14.

[7] Arif M, Maulana H, Ningtyias FW, Ririanty M. Food Coping Strategy oleh Keluarga Nelayan di Desa Puger Wetan Kabupaten Jember: Food Coping Strategy By Fishermen Families in PugerWetan , Jember District. AmertaNutr. 2022; 6: 1–14. https://doi.org/10.20473/amnt.v6i1.2022.1-14.

[8] Must, A. M., Phillips, S.M, Tybor, D.J., Lividini, K., hayes, C. The Association Between Childhood Obesity and Tooth Eruption. Obesity. 2012. 20 (10) : 2070–2074. https://doi.org/10.1038/oby.2012.23.

[9] Rai N, Mathur S, Sandhu M, Sachdev V. Early eruption of maxillary pre molar with turner's hypoplasia in a 5-years old boy. J Clin Diagn Res. 2016;10(8): ZD26-7.

[10] Koenela CR, Marjianto A, Prasetyowati S. Erupsi Gigi Molar PertamaPermanen Berdasarkan Letak Geografis Pesisir Pantai Dan Pegunungan DiKabupaten Pacitan (Eruption of Permanent First Molar Teeth Based on the Geographical Location of Coasts and Mountains in Pacitan Regency). J. Ilm. Keperawatan Gigi. 2020; 1: 12–22. https://doi.org/10.37160/jikg.v1i3.543.

[11] Rohma W. Analisis Kesadahan Air Tanah Dangkal Dalam Kaitannya Dengan Kebutuhan Air Domestik Di Sekitar Bukit Kapur Sadeng Kecamatan Puger (Analysis of Shallow Groundwater Hardness in Relation to Domestic Water Needs Around Bukit Kapur Sadeng, Puger District). Swara Bhumi E-Journal Pendidik. Geogr. FIS Unesa. 2018; 5.

[12] Listrianah, Zinur RA, Hisata LS. Description of permanent first molar tooth caries in students at State Elementary School 13 Palembang in 2018 (Gambaran Karies Gigi Molar Pertama Permanen Pada Siswa – Siswi Sekolah Dasar Negeri 13 Palembang Tahun 2018). J. Kesehat. Poltekkes Palembang. 2019; 13. https://doi.org/10.36086/jpp.v13i2.238.

[13] Contemporary orthodontics, sixth edition. Br Dent J. 2019;226(11):828. https://doi.org/10.1038/s41415-019-0429-x.

[14] Anggraini LD, Utomo RB, Sunarno, Pramono D. Premature Loss and Jaw Development (Premature Loss dan Perkembangan Rahang), Insisiva Dent. J. Maj. Kedokt. Gigi Insisiva. 2018. 7: 53–57.https://doi.org/10.18196/di.7297.

[15] Primasari A. 2018. Embryology and Growth and Development of the Oral Cavity (Embriologi dan Tumbuh Kembang Rongga Mulut). 2018. Medan : USU Press

[16] Baladina IM, Marjianto A, Isnanto. SLR . Faktor Penyebab Terlambatnya Erupsi Gigi (Factors Causing Delayed Tooth Eruption). J. Ilm. Keperawatan Gigi. 2022; 3:114–129.

[17] Arif M, Maulana H, Ningtyias FW, Ririanty M. Food Coping Strategy oleh Keluarga Nelayan di Desa Puger Wetan Kabupaten Jember (Food Coping Strategy By Fishermen Families in Puger Wetan , Jember District). Amerta Nutr. 2022; 6: 1–14. https://doi.org/10.20473/amnt.v6i1.2022.1-14.

[18] Muhartono R, Nurlaili. Debt As A Binding Relationship Between Fishers And ' Pengambe ' In The Jember Regency , East Java Province. J. Sos. Ekon. Kelaut. Dan Perikan. 2018; 13: 239–248.https://doi.org/10.15578/jsekp.v13i2.6869.

[19] Damongilala LJ. Kandungan Gizi Pangan Ikan (Fish Food Nutrient Content), 1st ed., CV. Patra Media Grafindo Bandung. Bandung. 2021.

[20] Lailasari D, Zenab Y, Herawati E, Wahyuni IS. Correlation between permanent teeth eruption and nutrition status of 6-7-years-old children. Padjadjaran J Dent. 2018; 30: 116–123.https://doi.org/10.24198/pjd.vol30no2.18327.

[21] Hartami E, Irmawati, Herawati. Perbedaan Kadar Kalsium Dan Fosfor Gigi Sulung Pada Anak Dengan DEF-T Rendah Dan Tinggi (Differences in Calcium and Phosphorus Levels in Primary Teeth in Children with Low and High DEF-T). E-Prodenta J. Dent. 2019; 3: 232–239. https://doi.org/: http://dx.doi.org/10.21776/ub.eprodenta.2019.003.02.2.

[22] Jasmine AB, Zulkarnain M, Sitorus RJ. Risk Factor Of Nutritional Status And Permanent Premolar-2 Eruption In 10 Years Old Children At Kecamatan Tuah Negeri regional Asia Tenggara. Sout. J. Kesehat. Poltekkes Palembang. 2021; 16: 15–21. https://doi.org/10.36086/jpp.v16i1.663.

[23] Amrullah SSA, Handayani H. Faktor-faktor yang mempengaruhi keterlambatan erupsi gigi permanen pada anak (Factors influencing delayed eruption of permanent teeth in children). Makassar Dent. J. 2014; 3: 1–5.

[24] Wangidjaja I. 2014. Anatomi Gigi (Dental Anatomy), 2nd ed. Jakarta : EGC.