

The Relationship Between Calcium Intake and Levels of Alkaline Phosphatase Enzyme with Delayed Eruption of Permanent Canines in Stunting Children

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Abstract

Tooth eruption is the movement or process of the appearance of teeth towards the oral cavity which begins when the teeth are inside the alveolar bone. Calcium intake is very important for tooth growth, so a deficiency of this substance can cause in a delayed tooth eruption. Calcium signaling is important for the regulation of immune responses. ALP is assisting neutrophils in the non-specific immune system. ALP is involved in the initiation stage of tissue mineralization and increases during times of proliferation and differentiation in the process of tooth formation. Nutrition is an important factor in the growth and development of teeth and jaws. Chronic nutritional deficiency has an impact on growth disorders known as stunting. The purpose of this study was to determine the relationship between calcium intake and alkaline phosphatase enzyme levels with delayed eruption of permanent canine in stunting children.

The method of this research was analytic with a cross-sectional to 50 stunting children that their age was 10 to 12 years who were divided into two groups, the normal and delayed eruption of permanent canines.

Based on the results of this research, there was no relationship between calcium intake and delayed eruption of permanent canines with a $p > 0.05$. There was a relationship between ALP levels and delayed eruption of permanent canines with a $p < 0.05$.

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Introduction

Tooth eruption is the movement or process of the emergence of teeth towards the oral cavity which begins when the teeth are in the alveolar bone. Tooth eruption is a complex process that can be influenced by several factors.¹ Tooth eruption can affect the growth of primary and permanent teeth. Nutrition is an important factor in the growth and development of teeth and jaws.^{1,2} Chronic nutritional deficiency has an impact on growth disorders known as stunting. Stunting causes cognitive and motor development disorders, not optimal physical body size and metabolic disorders that cause failure to thrive, so that children are too short compared to their age.³

Calcium deficiency will result in growth retardation. Calcium signaling is important for the regulation of immune responses. Alterations of calcium regulation in lymphocytes lead to various autoimmune, inflammatory and immunodeficiency syndromes. Lack of calcium can also have an impact on the growth of bones and teeth.^{2,4} Calcium is the main ingredient for the formation of teeth. Calcium intake is very important so that a deficiency of this substance can inhibit tooth growth and cause delayed tooth eruption. Delayed tooth eruption has an impact on disrupting the masticatory system to be inefficient.^{3,4}

Imperfect mastication will produce food particles that are not ready to be digested and absorbed in the digestive tract. Absorption of food that is not optimal will make the intake unable to be digested properly by the body so that it has an impact on quality of life. The canines are the teeth with the most delay in eruption. Therefore, the canines have the potential to experience delays in their eruption.

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So that the canines become a benchmark for delayed eruption. The development of the eruption of the canines is normally completed by the age of 10-12 years.^{1,3}

Other factors that can cause delayed tooth eruption are the vascular properties of the periodontium, root development, resorption and apposition.⁵ The bones and arches of the jaw are affected by the growth of the bones and teeth. Bone-forming cells are osteoblasts. Osteoblasts play a role in the mineralization of the organic matrix in the process of bone formation. Osteoblast activity forms bone by producing type I collagen and proteoglycans as bone matrix or osteoid tissue through a process called ossification, and when it is actively producing osteoid tissue, osteoblasts secrete large amounts of alkaline phosphatase enzymes.⁶⁻⁸

The main source of ALP is neutrophils. Osteoblasts, fibroblasts, and negative anaerobic bacteria also produce ALP. The function of neutrophils is to control bacterial attack by phagocytosis. The role of the alkaline phosphatase (ALP) enzyme is very important in the mineralization process, namely to prepare an alkaline (alkaline) environment in the formed osteoid tissue, so that calcium can easily be deposited in osteoid tissue.⁸⁻¹⁰ ALP causes an increase in phosphate concentration, so that calcium bonds are formed -phosphate in the form of hydroxyapatite crystals. Hydroxyapatite crystals that precipitate on bones and teeth illustrate that the alkaline phosphatase enzyme plays an important role in the formation of bones and teeth.⁸⁻¹⁰

ALP is one of the intracellular enzymes found in saliva. ALP is present in most tissues and organs, especially in bone. ALP activity is detected in Saliva. Saliva is a complex biological fluid consisting of a multiple secretions and useful biomarkers in the diagnosis of many diseases.¹¹ Salivary secretion plays an important role in oral health. Saliva as a biological matrix has been identified as an important initiative in the research.¹² Examination of saliva to determine levels of ALP enzymes has been proven to be an effective examination to be carried out.^{6,13,14}

It is still unclear whether there is a relationship between calcium intake and alkaline phosphatase levels with delayed eruption of permanent canines in stunted children. Therefore, researchers wanted to investigate further the

relationship between calcium intake and alkaline phosphatase levels with delayed eruption of permanent canines in stunted children.

Materials and methods

The type of research used is analytic research with a cross-sectional approach where the dependent and independent variables are examined at the same time. The population in this study were all stunted children aged 10-12. The total sample used in this study is 50 stunted children. The samples were divided into 2 groups, namely the normal tooth eruption group and the late tooth eruption group. Each group has 25 children.

The independent variables in this study were calcium intake and alkaline phosphatase levels. While the dependent variable in this study was the delay in the eruption of the permanent canines. Examination of calcium intake was carried out using the 24-hour Food Re-call interview method. Meanwhile, to calculate the levels of the enzyme alkaline phosphatase, it was carried out by taking saliva and calculating the levels using a Microplate Reader or Spectrophotometric.

Data analysis was carried out in a univariate way to describe each variable. The data normality test was carried out by the Shapiro-Wilk test. To determine the relationship between calcium intake and delayed eruption of permanent canines and the relationship between ALP enzyme levels and delayed eruption of permanent canines was carried out by a non-parametric test.

Results

Respondent Characteristics

The research was conducted on stunted children in the working area of the Lubuk Kilangan Health Center. The research sample is stunted children aged 10-12 years. The research sample at the age of 10 was 20 children, 11 years old was 16 children, and 12 years old was 14 children. The research sample was divided into two groups, each of which consisted of 25 stunted children with a total sampling of 50 stunted children. The group consisted of stunted children who had late eruption of permanent canines and stunted children who had normal eruption of permanent canines.

Relationship between Calcium Intake and Delayed Eruption of Permanent Canines in Stunted Children.

The Mann Whitney test was used to determine relationship between Calcium Intake and Delayed Eruption of Permanent Canines in Stunted Children. The result can be seen in Table 1.

Eruption of permanent canines	Calcium Intake			p,s
	N	Median (mg)	IQR (mg)	
Normal Eruption	25	108	158	,930
Late Eruption	25	111,30	105,3	

Table 1. Results of the Mann Whitney Test for the Relationship between Calcium Intake and Delayed Eruption of Permanent Canines in Stunted Children.

Eruption of permanent canines	ALP levels			p,s
	N	Median (ng/ml)	IQR (ng/ml)	
Normal Eruption	25	20,77	1.77	,014
Late Eruption	25	20,49	1.78	

Table 2. Results of the Mann Whitney Test for Relationship between ALP and Delayed Eruption of Permanent Canines in Stunted Children.

Based on table 1.2, it can be concluded that ALP levels in the late eruption group were lower than the normal eruption group with a median value of 20.49 ng/ml compared to 20.77 ng/ml which was statistically significant with a p value <0.05.

Based on table 1.1, there was a difference between calcium intake in the group with late eruption of permanent canines which was higher than the group with normal permanent canine eruption with a median value of 111,30 mg compared to 108 mg which was statistically not significant with a p value > 0.05.

Relationship between ALP with Delayed Eruption of Permanent Canines in Stunted Children.

The Mann Whitney test was used to determine relationship between ALP with Delayed Eruption of Permanent Canines in Stunted Children. The result can be seen in Table 2.

Discussion

Based on the statistical results in table 1. it was concluded that there was no significant relationship between calcium intake and delayed eruption of permanent canines. The difference between median value of calcium intake in the group with late eruption of permanent canines was higher than the group with normal eruption of permanent canines.

Regulation of the Minister of Health of the Republic of Indonesia number 28 of 2019 concerning the recommended nutritional adequacy rate (RDA) for people in Indonesia states that the recommended calcium rate for children aged 10-12 years boys and girls per person per day is 1200 mg. Low calcium intake in both study groups can prove that calcium intake is a factor causing stunting. This is in line with research by Sari, et al in 2016 which stated that stunted children's calcium intake is lower than children who are not stunted.¹⁵

Yudiya et al in 2020 also obtained the same results by stating that nutrition had no significant relationship with delayed eruption of permanent canines⁷. Delayed tooth eruption has other factors such as genetics, race, sex, systemic disease, and hormones. Nutritional factors associated with the study of the relationship between nutritional status and tooth eruption turned out to only have a portion of 1% while the percentage of the biggest factor causing delays in tooth eruption was genetic factor as much as 78%. Genetic factors are dominating factors.^{16,17}

Genetic factors play a role in tooth development and tooth eruption. Un Lam et al in 2016 in their cross-sectional study found differences in tooth eruption times in different races. Tooth eruption in children of the Chinese race occurs earlier than in the Malay and Indian races. The teeth eruption time of the Indian race is slower than that of the Malay race.¹⁸

Things that can cause delays in the eruption of permanent teeth locally, include trauma and dental abnormalities. Disturbance of the periodontal tissue can occur due to trauma in the form of ankylosis and premature exfoliation of primary teeth or early extraction due to caries which will affect bone resorption and apposition.^{13,19,20}

Apart from ankylosis, abnormalities in the teeth that can affect delays in tooth eruption are

dilacerations. Dilacerations can be interpreted as irregularities that occur during the development and growth of teeth which cause changes in the axial relationship between the crown and the root, loss of the interseptal bone of the periodontal tissue. Dilacerations caused by trauma that can change the condition of primary teeth. Trauma to the primary teeth can push the primary teeth in and suppress the seeds of the permanent teeth that are in the process of growing.^{13,19}

The results of the statistical tests in table 2 show that there is a significant relationship between levels of the enzyme Alkaline phosphatase and delayed eruption of permanent canines in stunted children.

Alkaline Phosphatase is a membrane bound glycoprotein involved in the maintenance of alveolar bone. ALP produced by osteoblast cells plays a role in the mineralization process of alveolar bone. Alveolar bone is an important periodontal tissue in tooth eruption which is a place for growth and development at the initiation stage of teeth.⁶ This is also supported by the 2020 Judge who also stated that ALP is involved in the initiation stage of tissue mineralization and increases during the proliferation and differentiation period in the tooth formation process.¹⁸

ALP levels in this study concluded that the late eruption group was lower than the normal eruption group with a median value of 20.49 ng/ml compared to 20.77 ng/ml. These results indicate that delayed eruption is a dentition disorder associated with ALP levels. ALP levels in the body will affect the growth and development of the teeth which has an impact on the disruption of the tooth eruption process.

Cells that play a role in the formation of teeth are called odontoblasts. Odontoblasts form the peripheral layer of the pulp whose function is to synthesize matrix so that it undergoes mineralization which is called dentine. Odontoblast cells will synthesize ALP which is important in initiating mineralization. ALP is often used as a biomarker to analyze odontoblast activity as an initial marker indicating that cells are undergoing a phase of differentiation. If there is a disturbance in ALP levels, it will certainly affect the formation of teeth.^{9,18}

Examination of ALP in saliva was carried out in a study by Pradeep, et al in 2020 which stated that ALP is a biomarker in saliva in conditions of infection and abnormalities in the

oral cavity.^{20,21} This is also supported by the research by Sandesh, et al in 2018 which also found a correlation between ALP levels in saliva and the age of the jaw bones.²²

It is proven that there is a significant relationship between ALP levels and delayed eruption of permanent canines in stunted children. Examination of ALP levels in saliva can be suggested as a biomarker to detect delayed eruption of permanent canines in stunted children.

Conclusions

The conclusion in this study was that there was no significant relationship between calcium intake and delayed eruption of permanent canines in stunted children. Meanwhile, there is a significant relationship between Alkaline phosphatase enzyme levels and delayed eruption of permanent canines in stunted children.

Declaration of Interest

The authors report no conflict of interest.

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