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Prevalence and types of ectopic eruption of first permanent molars in children in Talca, Chile

Bárbara Medina García[1], Alejandro Hidalgo Rivas[1], César Celis Contreras[1], Edgard Palma Díaz[2]

1. Departamento de Pediatría Estomatológica. Programa de Especialización en Ortodoncia y Ortopedia Dentofacial. Universidad de Talca, Chile.
2. Departamento de Estomatología. Programa de Especialización en Imagenología Oral y Maxilofacial. Universidad de Talca, Chile.

Corresponding author:
Edgard Palma Diaz
E-mail: edgard.palma@gmail.com

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ABSTRACT

Introduction: The lateral zone of the temporary dental arch, formed by the canine and temporary molars, is important for the consolidation of a correct final occlusion. However, its integrity can be altered by the ectopic eruption (EE) of the first permanent molar (FPM), so it is important to know its epidemiology. **Objective:** To determine the prevalence and location of different types of FPM EE in patients from 4 to 7 years old, treated at the Dental Clinical Center of the University of Talca, Chile. **Materials and methods:** Observational, analytical, and cross-sectional

study. We evaluated 474 orthopantomographies, determining the frequency and distribution of ectopic eruption (EE) of FPM in its different types, by dental quadrant. The association between affected subjects and sex was determined, and the difference in proportions between maxillary/mandible, one arch/two arches, and unilateral/bilateral. **Results:** Of 474 orthopantomographies, the distribution of patients with and without EE was 34.6% and 65.4% respectively. At the age of 4 years, no patients were found with EE of FPM, but this was found to increase up to 42% at 7 years. Of the total, patients with EE of FPM in the maxilla were 31.2% and in the mandible 5.1%. The EE of FPM in one arch was 96.3% and in both arches 3.7%. **Conclusions:** The prevalence of EE of FPM was approximately one-third of the studied population, with no gender predilection. EE of FPM was diagnosed on patients since 5 years old. EE of FPM was found to be significantly more prevalent in the maxilla than in the mandible. The frequency of reversible EE was the lowest, compared to patients without EE and those with irreversible EE. EE of FPM occurred significantly more frequently in the maxilla than in the mandible.

Keywords: Ectopic eruption, first permanent molar, pediatric dentistry

INTRODUCTION

Ectopic eruption (EE) of the first permanent molar (FPM) is a local alteration characterized by the abnormal eruption of the FPM, which impacts the crown and/or root of the second primary molar (SPM) distally[1]. EE of the FPM is frequent and of multifactorial etiology, which includes a genetic component and local factors[1], some examples of local factors involved are infra occlusion of primary molars, agenesis of second premolars, and supernumerary teeth[1,2]. A significant association has also been established between upper EE FPM and dental-skeletal characteristics, such as maxillary hypoplasia and crowding in the upper dental arch[2,3]. The most frequent consequence of FPM EE is root resorption (RR) of the SPM, which even causes its premature exfoliation[3,4].

Premature exfoliation of the SPM affects its role in the conformation of the definitive dental arch and its occlusal relations, as it forms part of the mesiodistal width (MDW) of the temporary dental arch[2], in addition, the temporary teeth are a guide for the eruption of the permanent teeth. The MDW consists of the canine, first primary molar, and SPM and can be affected by the RR of primary teeth caused by the eruption of permanent teeth[2]. However, permanent tooth eruption does not always reduce the MDW[3]. FPM EE, even if it does not always reduce MDW, can modify the normal eruption sequence and alignment of the dental arches[3]. In addition, EE can cause FPMs to fail to reach the occlusal plane or erupt outside their proper labial-palatal/lingual axis[2].

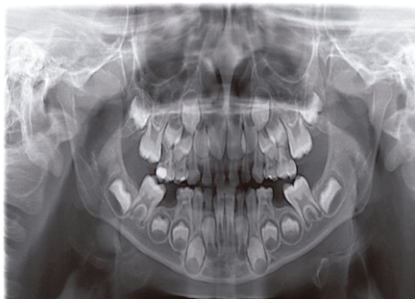
EE is classified as reversible and irreversible. In reversible EE, the FPM spontaneously corrects its eruption direction, after producing RR of the STM[5]. In irreversible EE, the FPM produces RR of the STM and partially erupts, becoming retained by the STM, until it is treated orthodontically, or the STM is prematurely exfoliated[6,7]. Therefore, it is necessary to have a better knowledge of the prevalence and characteristics of the different types of EE, which will allow the development of clinical guidelines for their timely diagnosis and treatment. The aim of the present study was to determine the prevalence and location of the different types of FPM EE in orthopantomographies of patients aged 4 to 7 years in Talca, Chile.

MATERIAL AND METHODS

An observational and cross-sectional study was conducted to evaluate all the orthopantomographies of patients aged 4 to 7 years who were seen at the Dental Clinic Center of the University of Talca over a period of twelve months. All the radiographs that were previously indicated and taken were included, for diagnostic and dental treatment needs. No radiographs were taken for research purposes. An anonymized database was used, in which only sex and age were recorded. The names of each patient were replaced with a correlative number. The present research was approved by the Bioethics Committee of the University of Talca (Folio 2013-089).

Orthopantomographies were included if they presented in all quadrants a physiological eruptive process of the FPM regarding the patient's age, without the presence of RR in the STM. Cases were excluded with the presence of odontogenic tumors, cysts, giant cell lesions, and benign or malignant neoplasms of bone tissue of the jaws; advanced physiological RR of the STM; current or previous orthodontic treatment; history of dentoalveolar trauma in the teeth involved; defects in radiographic acquisition. Also excluded were quadrants with absence of teeth, presence of caries, restorations, and/or pulp treatments in the STM. The types of FPM EE and their definitions used in the present study are shown in Table 1. An observer (BM) previously standardized with a radiology specialist with more than 5 years of experience (CC) analyzed the orthopantomographies and recorded the data. The observer obtained a good level of inter-examiner agreement (Kappa 0.778).

Table 1.
Types of ectopic eruption of the first permanent molar (EE of the FPM) and their respective definitions used in the present study.

Type of ectopic eruption	Definition	Image	Percentage of EE types found
Irreversible ectopic eruption	RR at least of the disto-labial root of the STM by EE of the FPM, which is observed retained and without reaching the occlusal plane[6,7].		14%
Reversible ectopic eruption	The FPM in EE, spontaneously corrected its direction, reaching the occlusal plane, after producing RR, observable distal of the STM[3,5].		86%

Images obtained from the population studied. RR: Root resorption. STM: Temporary second molar.

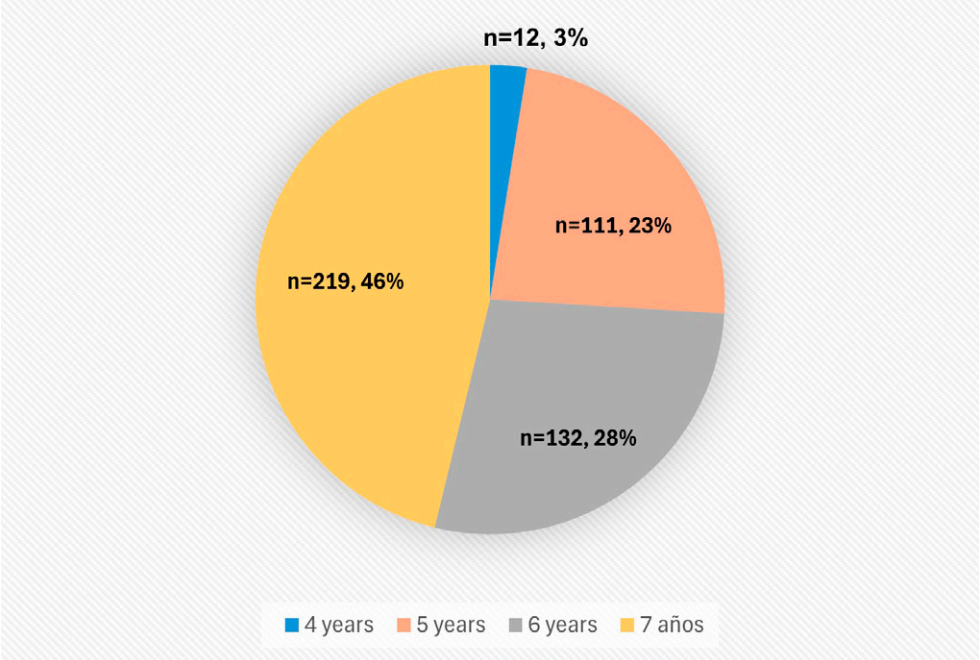
In a Microsoft Excel spreadsheet, the gender (male/female), age, presence of EE of the FPM (with/without), and type of EE (reversible/irreversible) were recorded for each orthopantomography. The location of the FPM with EE was also recorded according to the dental arch (maxillary and/or mandibular) and quadrant of the arch (I-IV). It was recorded whether the patient with EE of the FPM had one arch affected or both and whether the patient with EE of the FPM had uni- or bilateral EE in the maxilla and/or mandible. In the radiographs with excluded quadrants, the unilateral/bilateral location was not determined.

The distribution of patients with EE and without EE of the FPM was established. The distribution by gender and frequency by age of patients with FPM EE was established. The frequency of patients without EE, with irreversible EE, with reversible EE, and excluded quadrants was also established. The distribution of patients with FPM EE and without FPM EE in the maxilla and mandible, and the frequency of unilateral/bilateral FPM EE in the maxilla and mandible were determined.

Statistical analysis was performed with SPSS (Statistical Package for Social Sciences) software version 15.0 for Windows (International Business Machines Corp.). Fisher's test was used to determine the association between patients with FPM EE and gender. The asymptotic Z-test in RCommander version 2.14 for Windows (Fox, J) was used to determine the difference in proportions between maxillary/mandibular and one-arch/bi-arch locations at the 95% significance level.

RESULTS

A total of 474 orthopantomographies were included, 53.8% (n=255) were boys and 46.2% (n=219) were girls. The age distribution of the studied group is shown in Graph 1. Of the patients with EE, 50.6% (n=83) corresponded to boys and 49.4% (n=81) to girls, no statistically significant association was found between patients with EE of the FPM and gender, as shown in Table 2.



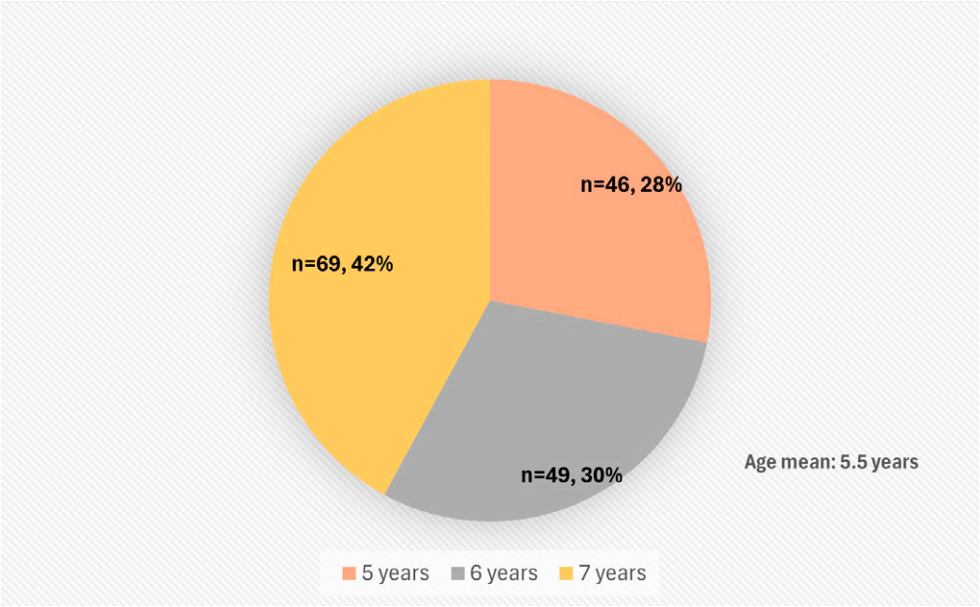
Graph 1. Age distribution of the studied group.

Table 2.
Distribution of subjects with EE of the FPM according to gender.

Ectopic eruption of the first molar		
Gender	**n**	**%**
Girls	81	49.4 %
Boys	83	50.6 %
Total	164	100 %

n: frequency. %: percentage. Fisher's test (p-value = 0.180) determined that there was no statistically significant association between affected subjects and gender.

Of the 474 orthopantomographies, the distribution of patients with and without EE was 34.6% (n=164) and 65.4% (n=310) respectively. When analyzing the frequency by age of patients with EE of the FPM, it was found that 42% corresponded to 7-year-old children; the distribution for ages 5 and 6 years was very similar (Graph 2).



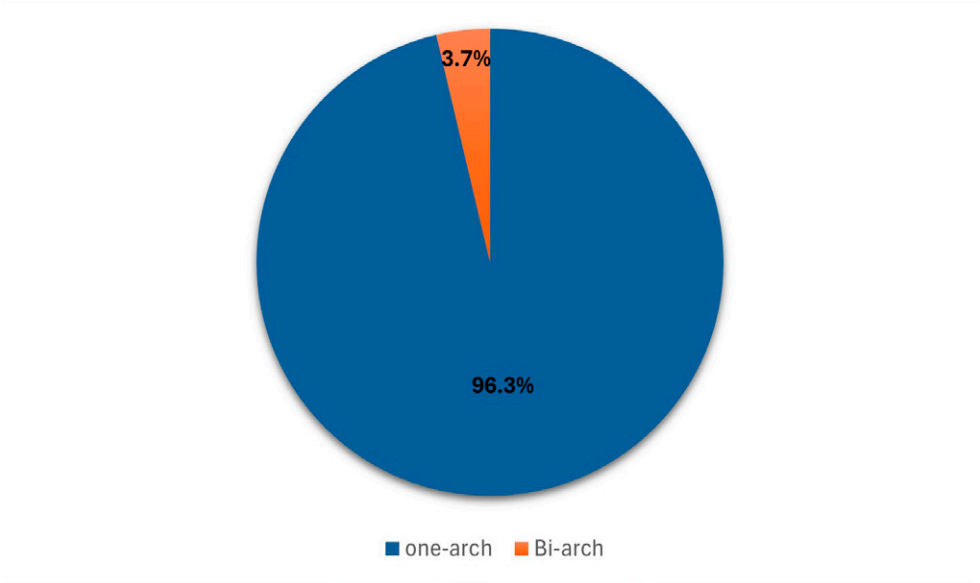
Graph 2. Frequency by age of patients with ectopic eruption of the first permanent molar.

The EE of the FPM according to maxillary/mandibular location, was significantly higher in the maxilla ($p < 0.001$), with 31.2% of the total studied subjects (with and without EE). The rest of the results are shown in Table 3. The one-arch prevalence of FPM EE was significantly higher 96.3% than bi-arch 3.7% ($p < 0.001$) (Graph 3).

Table 3. Distribution of patients with and without EE, according to location (maxillary/mandibular).

	Maxilla		Mandible	
Patients	**n**	**%**	**n**	**%**
No EE	326	68.8 %	450	94.8%
With EE	148	31.2 %	24	5.1%
Total	474	100 %	474	100%

n: frequency. %: percentage.EE: ectopic eruption. The EE of FPM was significantly higher in the maxilla ($p < 0.001$). The asymptotic Z test was used.



Graph 3. Percentage of one-arch/bi-arch patients with FPM EE.

DISCUSSION

The present study established the prevalence and location of the different types of FPM EE in children in Talca. Although some research in Latin America has studied FPM EE, it has been done with a diagnostic and therapeutic approach[2,3]. There are few studies similar to the present one, with an epidemiological approach, in the Latin American population. Such studies are important for the generation of guidelines and public policies.

Orthopantomography, which is widely used in children, was used in the present study[8]. The radiographic indications for children after the eruption of the first permanent tooth have been proposed by the American Academy of Pediatric Dentistry[9]. The indicated radiographic exam is orthopantomography plus bitewing, or bitewing plus dentoalveolar radiographs in selected teeth[9,10]. Intraoral radiographs were not available in the present investigation and were not considered for research purposes for ethical reasons. Cone-beam computed tomography (CBCT) has shown better performance for RR detection compared to conventional radiographs[11-13].

However, its higher radiation dose compared to conventional radiographs does not allow it to be recommended as the test of choice for diagnosis of FPM EE. It is necessary to evaluate the cost/benefit of using CBCT as a supportive examination for the diagnosis of FPM EE.

Regarding the age of patients with FPM EE, in the present study, on average it was 5.5 years, which differs from the previously reported range of 7.5-6.8 years[1,14]. Thus, 28% of 5-year-old patients with FPM EE were observed. This means that FPM EE can already be diagnosed radiographically at 5 years of age, which is in accordance with the literature[1]. The timely diagnosis of FPM EE reduces the alterations that it can cause in the occlusion, as well as the time and complexity of orthodontic treatment of such alterations[2]. In addition, the timely diagnosis of FPM EE reduces economic costs and risks derived from orthodontic treatment, such as RR, caries, and gingival problems[11]. Based on the results of the present investigation, it is suggested that orthopantomography of 5-year-old patients could be a timely diagnostic strategy to avoid or minimize the sequelae of FPM EE. Concerning gender, previous studies agree with the present one in that there is no significant difference according to sex in patients with FPM EE[1,14].

In relation to the prevalence of FPM EE, the present study found it in approximately one-third of the patients, a high figure compared to the previously reported range of 2 to 6%[1,6,7]. This difference may be due to the use of different imaging tests and different observation criteria in terms of observer characteristics and observation methods. Therefore, it is desirable to establish standardized research protocols that unify the imaging exam used and the observation. In addition, the support of an expert radiologist is suggested for the observation, which is not seen in the methodology of other studies.

As for the location of FPM EE, some studies investigate it only in the maxilla[3,5,6]. This is probably due to the higher prevalence of FPM EE in the maxilla[1,2]. The present study found 31.2% of FPM EE in the maxilla. This finding differs from the 57.5% reported by other authors[1]. Regarding lower FPM EE, its prevalence in the present study reached 5.1%, while in Güven's study, it was 42.5%[1]. These values indicate the need to know the characteristics of lower FPM EE, which would allow better orientation of treatment and prognosis. For example, the occlusal alterations caused by lower FPM EE could require greater effort and time for correction, compared to those caused by upper FPM. This is due to the fact that there is a lower rate of orthodontic movement in the mandible, because of the higher bone density compared to the maxilla[15].

With respect to the prevalence of reversible FPM EE, in the present study, it was approximately one-third, being significantly higher in upper FPM than in lower FPM. The reversible EE of the FPM in the present study was 86%, close to the 71% reported by Dabbagh *et al*.[5] even though their study was performed on bitewing radiographs. Concerning the predictability of FPM EE, it has been studied in terms of the factors that condition it, for which Sun *et al*. used orthopantomographies[6]. These authors found a close relationship between the possibility of upper FPM EE and the increased mesial angulations of both the FPM and the upper permanent second molar germ[6]. In terms of the predictability of reversible EE FPM, Dabbagh *et al*. found that the most reliable predictive factor was the increased magnitude of impaction[5]. The impaction magnitude was defined as the horizontal distance from the most convex area of the mesial contour of the permanent tooth to the plane tangential to the distal surface of the temporary tooth[14].

CONCLUSIONS

The prevalence of patients with FPM EE was approximately one-third of the population studied, with no gender predilection observed. Meanwhile, it was observed that FPM EE can be diagnosed as early as 5 years of age.

FPM EE, in its different types, was significantly more prevalent in the maxilla than in the mandible, with the frequency of reversible EE being the lowest, compared to patients without EE and those with irreversible EE. FPM EE was significantly more prevalent in one arch.

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