Original Article

Ectopic Eruption of the Maxillary First Permanent Molar: Characteristics and Occurrence in Growing Children

Elena Barberia-Leache[a]; María Cruz Suarez-Clúa[b]; Dolores Saavedra-Ontiveros[c]

Abstract: The purpose of this study was to determine the characteristics and occurrence of the ectopic eruption of the maxillary first permanent molar in a sample of growing Spanish children. A descriptive, observational, retrospective study was done using the radiographs of 509 consecutive patients, who were in the first phase of mixed dentition. A method was designed to evaluate the amount of pathologic resorption of the second maxillary primary molar and the impaction of the first permanent molar measured in millimeters. Statistical analysis of the studied variables was done using chi-square, analysis of variance, and Pearson correlation coefficient. The frequency of occurrence was 4.3% with no differences in both sexes. Of these, 36.4% were unilateral and 63.6% bilateral with a right:left relation of 3:1. Of the 36 ectopic molars, 69.4% self-corrected spontaneously. In such cases, the pathological resorption of the root of the second maxillary primary molar and its adverse clinical implications were persistent. The relation between self-correction and impaction was 2.27:1. The average impaction on the right side was 2.91 mm and 1.6 mm on the left side. Correlation between the magnitude of resorption and grade of impaction was not observed. Although resorption was found on grades I and II, spontaneous self-correction could occur without arch length loss. However, on grade III or more, therapeutic intervention has to be done. The benefit of early diagnosis and treatment of the maxillary first permanent molar is the prevention of the premature loss of second maxillary deciduous molar and the resulting malocclusion. (*Angle Orthod* 2005;75:610–615.)

Key Words: Ectopic eruption; Pathological resorption; Eruption anomalies; Atypical resorption

INTRODUCTION

The eruption process is a very complex phenomenon in which multiple factors act synchronously to achieve a normal eruption. However, this process might be altered by genetic, molecular, cellular, or tissue causes.[1] Among the disorders related to dental eruption, most occur during the tooth transition stage. Early diagnosis and the early start of treatment using the natural forces of eruption allow the prevention of more complicated malocclusions.[2]

Ectopic eruption reflects the eruption of a tooth in an abnormal position.[3] The most frequently found ectopic teeth are the maxillary first permanent molars and canines, followed by the mandibular canine, mandibular second premolar, and the maxillary lateral incisors.[4,5] Ectopic eruption and impaction should be differentiated. In the latter case, the tooth cannot erupt because something impedes it and not because of its ectopic position.[6,7]

Ectopic eruption of the maxillary first molars shows a variable prevalence that ranges between 2% and 6%, depending on the population studied.[8,9] According to Moyers,[10] 3% of American children present this anomaly. In studies done in 1947, Cheyne and Wessels[11] reported that one out of 50 children was affected, being more frequent in the maxilla and in males. Young[12] observed that it affected 3% of a group of 1619 boys and girls. Chintakanon and Boonpinon[13] found a prevalence of 0.75% and that the severity of ectopic eruption and root resorption of the deciduous second molar were also more pronounced in the maxilla than in the mandible.

[a] Professor, Department of Preventive, Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Complutense University, Madrid, Spain.

[b] Assistant Professor, Faculty of Dentistry, Department of Preventive, Pediatric Dentistry and Orthodontics, Complutense University, Madrid, Spain.

[c] Clinical Researcher, Gregorio Marañón University General Hospital, Genetic Unit, Madrid, Spain.

Corresponding author: Elena Barberia-Leache, PhD, MD, DMD, Department of Preventive, Pediatric Dentistry and Orthodontics, Faculty of Dentistry, Complutense University, Plaza de Ramon y Cajal s/n Madrid, Madrid 28020, Spain (e-mail: barberia@odon.ucm.es).

Accepted: May 2004. Submitted: March 2004.

© 2005 by The EH Angle Education and Research Foundation, Inc.

Carr and Mink showed that the frequency is higher in cleft lip palate children than in normal children.[14] Also, Bjerklin found a prevalence of 21.8% in cleft children vs 4.3% in the general population. On the other hand, in siblings of children with ectopic eruption, a prevalence of 19.9% was found, which is much higher than in the general population, suggesting a genetic background.[15]

The cause of ectopic eruption of the maxillary first permanent molar is not well known and is considered to have a multifactorial etiology.[16–20] Before emerging, the tooth germ of the maxillary first molar is oriented downward, backward, and outward. As eruption continues, the tooth adopts a more vertical position.[21]

Among the factors that could cause this anomaly are discrepancies in bone-tooth size or an alteration in the chronology of bone growth at the tuberosity region in relation to the calcification and eruption of the molar. Other dental causes are unfavorable second primary molar crown morphology or an abnormal eruption angle of the first permanent molar. Heredity is another of the factors considered.[16–20]

The diagnosis is usually done at a routine radiographic examination before the eruption of these teeth, usually between five and seven years of age. The maxillary first permanent molar is regarded as ectopically erupted if on the radiograph it appears in a superposed image and impacted in the distobuccal root of the deciduous tooth. The grade of impaction of the first molar and the resorption of the primary tooth may also be determined.[22–24]

This pathology should be taken into consideration during a clinical examination. The unilateral or bilateral delay in the emergence of the maxillary first permanent molar[25] or an eruption path in which the distal cusps are emerging before the mesial cusps should make us think of this process.[26] A follow-up radiograph through time will allow differential diagnosis between reversible and irreversible ectopic eruption. In both cases, a pathological resorption of the distal root of the deciduous second molars is produced. The irreversible form could cause exfoliation of the deciduous second molars with the resulting mesial migration of the first molar occupying the space of the second premolar. This will provoke a decrease in arch length and delay the eruption of the maxillary second premolars.[27–29]

A permanent molar with a minor degree of impaction, limited to the middle or less of its marginal border, usually will spontaneously correct. However, if there is a greater degree of impaction including the complete marginal border, it usually does not self-correct. In general, resorption is stopped once the first permanent molar corrects its eruption path and secondary dentin is usually deposited in the area of resorption, obliterating the exposed dentin.[30–32] When ectopic eruption is reversible, the eruptive path is self-corrected by seven years of age in the majority of cases.[33]

The aim of this study was to describe, by means of retrospective research, the presentation characteristics and occurrence of the ectopic eruption of the maxillary first permanent molar and its correlation with the pathological resorption of maxillary second deciduous molar in a group of untreated normal children of ''The Program of Integral Dental Attention on Infant Patients'' of the Faculty of Dentistry of the Complutense University of Madrid.

MATERIALS AND METHODS

A sample of 509 consecutive patients, aged six to nine years, in the early mixed dentition stage was included in this study. They were reviewed from January 1998 to December 2002. As a routine procedure, all were evaluated with intraoral left and right bitewing radiographs, taken every six months. For the purpose of this study, the maxillary first permanent molar was evaluated on radiographs after the mandibular first permanent molar emerged. All the radiographs were compared in each patient, along all the usual follow-up time. To rule out the possibility of error due to radiographic magnification, the crown measurements in bitewing radiographs and in dental casts were compared, and no significant differences were present.

Children suffering from any syndrome or craniofacial malformations, systemic disease with oral repercussions, or those with atypical resorption of primary molars for reasons other than the permanent molar were excluded.

In the affected children, two types of ectopic eruption were distinguished:

- Reversible ectopic eruption—the permanent molar spontaneously self-corrects its trajectory and erupts in a normal position, leaving behind bony resorption as permanent sequelae.
- Irreversible ectopic eruption—the permanent molar remains blocked against the deciduous second molar.

To measure the resorption of the deciduous second molar, a semiquantitative grading system was designed by the authors. The magnitude of impaction of the permanent molar was measured in millimeters.

Resorption

Four grades were established according to the magnitude of the primary second molar distal root lesion (Figure 1a through d). Grade I: mild—limited resorption to cementum or with minimum dentin penetration; grade II: moderate—resorption of the dentin without

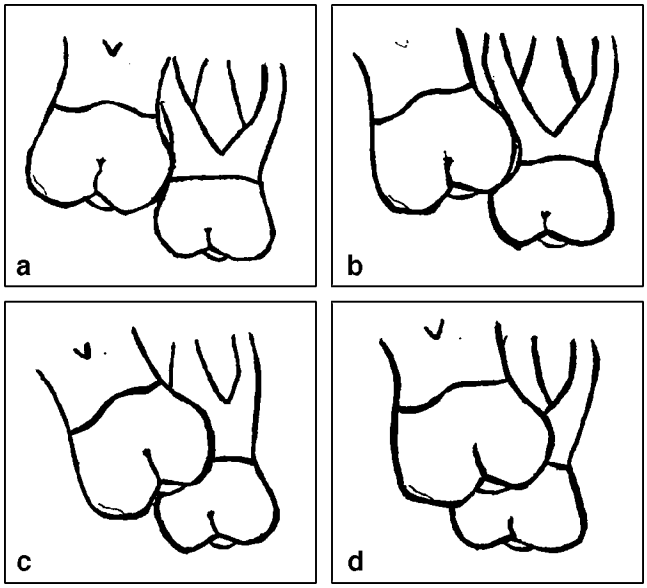


FIGURE 1a–d. Representation of the grades I, II, III, and IV of resorption of the second temporary molar.

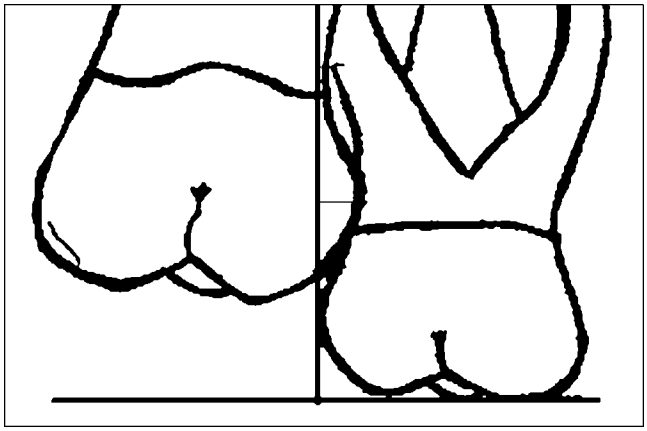


FIGURE 2. Draft of the impaction measurement.

pulp exposition; grade III: severe—resorption of the distal root leading to pulp exposure; grade IV: very severe—resorption that affects the mesial root of the primary second molar.

Impaction

A tangential plane was drawn up to the distal wall of the primary second molar perpendicular to its occlusal plane. From the prolongation of the distal plane toward the apical region, the distance of the maximum mesial convexity of the fixed permanent first molar was measured. The magnitude of impaction was valued in millimeters (Figure 2).

The statistical analysis was carried out by means the SPSS program (v. 11.0, SPSS Inc., Chicago, Ill) using the chi-square to compare frequencies of each variable studied, the Pearson correlation to analyze whether there were some quantitative relationship between impaction and resorption, and ANOVA for multiple variable analysis (sex, side, uni- or bilateralism, impaction or self-correcting, age of self-correcting, age when the diagnosis was made, first or subsequent visit).

RESULTS

Of the 509 reviewed cases, 22 cases were diagnosed with ectopic eruption of the maxillary first permanent molar, giving a frequency of 4.3%. Distribution by sex showed that 59% (13 patients) were boys and 41% (nine patients) were girls. The 1.4:1 male:female relation found was not significant ($P > .05$).

Of the ectopic eruption patients, 54.5% were diagnosed at the time of a first visit at an average age of eight years and zero months. The remaining 45.5% of the ectopic eruption patients were diagnosed at regular six-month visits at an average age of six years and five months. Statistically, there were no significant differences ($P > .05$). The overall average age found in the affected group was seven years and six months.

The anomaly occurred unilaterally in 36.4% of the affected patients and bilaterally in 63.6%. The unilateral:bilateral relation found was 1.75:1 ($P > .05$ = NS). In the unilateral cases, 75% presented a right side location, whereas 25% were located on the left side. Hence, the 3:1 right:left relation was significant ($P < .05$).

The analysis of multiple variables including sex of child, bilateral or unilateral, and affected side (if unilateral affectation) showed no positive correlations, except for boys with unilateral ectopic eruption on the right side ($P < .05$). The findings of affected patients are summarized in Table 1.

Regarding the prognosis of the process, of 36 ectopic molars in 22 children, 25 (69.4%) were self-corrected (Figure 3) and 11 (30.6%) remained impacted (Figure 4).

The analysis of the correlation of the clinical situation of ectopic molars (self-corrected or impacted) and the uni- or bilateral condition demonstrated only a statistically significant correlation between spontaneous self-correction and the bilateral situation ($P < .05$). The ratio of spontaneous molar self-correction and molar impaction was 2.27:1.

The number of millimeters that the first permanent molars remained impacted, specifying the side and the amount of horizontal impaction, are shown in Table 1. The average impaction was 2.91 mm on the right side and 1.6 mm on the left side, and this difference is statistically significant ($P < .05$).

The average age of the children with self-corrected molars was seven years and five months, and the av-

TABLE 1. Data of the Patients who Presented Ectopic Eruption of the Superior First Permanent Molars[a]

No.	Sex	Resorption, Rt	Impaction, Rt	Resorption, Lt	Impaction, Lt	Type, Rt	Type, Lt	Age, y/mo	Visit
1	Female	II	—	I	—	SC	SC	6/8	First v
2	Female	III	3.5	III	2	IM	IM	8/11	First v
3	Male	III	3	II	—	IM	SC	6/4	First v
4	Male	III	2	II	—	IM	SC	6/10	Fv
5	Male	II	—	—	—	SC	—	7/10	Fv
6	Male	I	—	II	—	SC	SC	7/3	Fv
7	Male	I	—	—	—	SC	—	6/0	Fv
8	Female	III	3	IV	2	IM	IM	6/6	Fv
9	Male	II	—	I	—	SC	SC	8/10	First v
10	Male	III	—	III	2	SC	IM	6/11	First v
11	Male	II	—	II	—	SC	SC	7/0	Fv
12	Female	—	—	IV	1	—	IM	10/1	First v
13	Male	—	—	II	1	—	IM	8/1	Fv
14	Female	II	—	I	—	SC	SC	8/11	First v
15	Female	III	2	I	—	IM	SC	6/9	Fv
16	Female	III	—	—	—	SC	—	8/11	First v
17	Female	II	—	II	—	SC	SC	7/11	First v
18	Male	II	—	II	—	SC	SC	6/9	First v
19	Male	I	—	—	—	SC	—	8/11	First v
20	Male	I	—	—	—	SC	—	8/7	Fv
21	Female	I	—	II	—	SC	SC	7/11	Fv
22	Male	IV	4	—	—	IM	—	6/11	First v

[a] Rt indicates right side; Lt, left side; SC, self-correction; IM, impacted molar; First v, preliminary visit; Fv, follow-up visit.

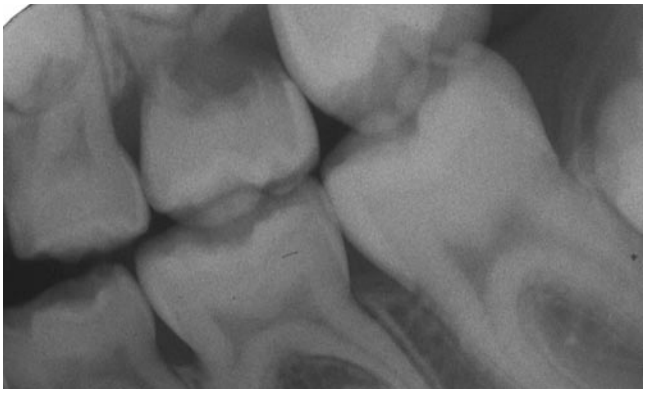


FIGURE 3. Self-corrected ectopic eruption. Radicular resorption as a consequence can be appreciated.

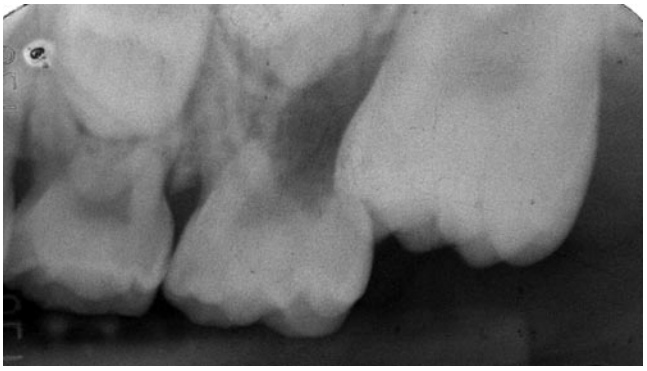


FIGURE 4. Impacted ectopic eruption. The first permanent molar is seen locked.

TABLE 2. Distribution Percentages of the Grades of Resorption in Each Side and Clinical Situation

	Self-corrected (%)		Impacted (%)	
Grades	Right	Left	Right	Left
I	35.7	36.36	—	—
II	50.0	63.64	—	20
III	14.3	—	83.33	40
IV	—	—	16.67	40

erage age of the children with impacted molars was eight years and two months ($P > .05$ = NS). The root resorption frequency of each degree of the deciduous second molar is shown in Table 1. The statistic analysis between the frequency of each degree of resorption in each affected side shows no significant differences ($P > .05$).

Relation between impaction and resorption

The grade of resorption of the deciduous second molars is expressed in Table 2. The clinical situation of self-correction or impaction of the permanent molar, as well as the affected side, is specified separately. The correlation between the resorption degree and the millimeters of impaction was significant ($P > .05$) neither on one side nor on the other.

DISCUSSION

The frequency of ectopic eruption of the maxillary first permanent molar observed in the present study

was 4.3%, similar to the prevalence reported by Bjerklin and Kurol[8] in 2903 healthy children. This suggests that both populations could have similar conditions. Nevertheless, other figures have been reported on other populations, and Young[12] found 3% and Cheyne and Wessels[11] recorded a 2% frequency. In these studies, the diagnostic criteria could vary if only the impacted molars were taken into account, ie, if the spontaneously self-correcting patients were omitted, the frequency of ectopic eruption in the present study would fall to 1.77%.

Some authors associate the ectopic eruption of the first permanent molars with other dental anomalies.[34] In the present study, these conditions were not taken into account because of the methodological design used.

It should be emphasized that the reason for consultation was not because of this pathology, although the child presenting pain of the neuralgic type in the zone of tooth impaction, on occasion, has been described. The diagnosis was determined by a delay or asymmetry in molar eruption and was radiographically confirmed. This fact reinforces the concept that a clinical examination is fundamental, but that a radiological diagnosis is definitive.[22–24]

Regarding sex, a great frequency was found among males coinciding with the literature.[15] The male:female ratio was 1.4:1, but the difference was not statistically significant, which indicates that ectopic eruption of the superior first permanent molar affects males and females equally.

The average age of the diagnosis in the whole group was seven years and six months. However, the earliest diagnoses generally were done in patients who were under dental follow-up control and had periodic examinations. Although the difference is not statistically significant, granting that the group is small, it does have clinical importance. The early diagnosis and treatment is the only way to stop the root resorption of the deciduous molar.

Of the observed cases, 63.6% of the ectopic eruption was found bilaterally, which was significantly greater than the 36.4% found unilaterally. In the literature, there is no reference to such a high frequency of bilateral cases, and this can be related to the diagnostic criteria. If the diagnosis was done without taking into account the root resorption of the deciduous second molars and if a number of self-corrected ectopic molars were not taken into consideration, the total frequency and bilateralism would be less. The higher frequency of the right side affection in relation with the left one (3:1) is hard to explain, but as in other multifactorial anomalies, there were side frequency variations.

The magnitude of permanent molar impaction and the severity of the deciduous second molar root resorption showed a great variability. The average measure of the impaction was 2.91 mm for the molars on the right side and 1.6 mm for those on the left side, which once again emphasizes that ectopic eruption on the right side is more frequent and of a greater magnitude.

Related to the prognosis, there was spontaneous self-correction in 69.4% of the cases, but in 30.6% the molar stayed locked in place. These results are similar to those obtained by Young.[12]

In spite of the self-correction of the ectopic eruption in some patients, the damage on the deciduous molar was important. In 63% of these cases the resorption of the primary molar included the total thickness of the distal wall, and 14.3% of the cases presented resorption grade III, leading to pulpal exposure.

In most of the impacted molars (80%), the lesion on the deciduous molar was either severe or very severe. There was no significant statistical correlation between the degree of primary molar resorption and the millimeters of permanent molar impaction because minute impaction sometimes causes severe resorption and relatively greater impactions give rise to lesser pathologic resorption.

Regarding evolution, grades I and II normally self-correct spontaneously and grades III and IV remain impacted. No significant statistic correlation was found. There was some self-corrected grade III cases and some grade I cases that stayed impacted.

CONCLUSIONS

Although resorption is present in grades I and II, spontaneous self-correction can be expected without treatment, but if it is grade III or more, the majority of the cases do not self-correct. The treatment to obtain a normal eruptive pathway and to preserve the deciduous molar should be performed as early as possible.

On the other hand, there was no statistically significant correlation between the degree of first molar impaction and the deciduous molar root resorption because a small impaction of the permanent molar does not mean that the deciduous molar lesion would be small. With substantial displacements, a proportionally diminutive lesion can exist and vice versa. Therefore, the two parameters should be evaluated objectively and separately for which we have proposed a method.

REFERENCES

1. Hernández JM. Mecanismos y teorías de la Erupción Dentaria. Estado actual. *Rev Eur Odont-Estomatol.* 2002;14: 349–356.
2. Braham RL, Morris ME. *Textbook of Pediatric Dentistry.* 1st ed. Baltimore, Md: Williams and Wilkins; 1980:329–331.
3. Toutountzakis N, Kastaris N. Ectopic eruption of the maxil-

lary first permanent molar. *Orthod Epitheorese.* 1990;2: 117–128.
4. Wei SH. *Pediatric Dentistry: Total Patient Care.* 1st ed. Philadelphia, Pa: Lea and Febiger; 1988:462–463.
5. Sim JM. *Movimientos dentarios menores en niños.* 1st ed. Buenos Aires, Argentina: Editorial Mundi; 1973:22–24.
6. Rasmussen P, Steen A, Berg E. Inherited retarded eruption. *ASDC J Dent Child.* 1983:268–273.
7. Weinberg MA, Eskow R. An overview of delayed passive eruption. *Compend Contin Educ Dent.* 2000;21:511–520.
8. Bjerklin K, Kurol J. Prevalence of ectopic eruption of the maxillary first permanent molar. *Swed Dent J.* 1981;5:29–34.
9. Kimmel NA, Gellin ME, Bohannan H, Kaplan AL. Ectopic eruption of maxillary first permanent molars in different areas of the United States. *J Dent Child.* 1982;4:294–296.
10. Moyers RE. *Manual de Ortodoncia.* 4th ed. Buenos Aires, Argentina: Editorial Médica Panamericana; 1992:129.
11. Cheyne YD, Wessels KE. Impaction of permanent first molar with resorption and space loss in region of deciduous second molar. *J Am Dent Assoc.* 1947;35:774–787.
12. Young DH. Ectopic eruption of the first permanent molar. *J Dent Child.* 1957;24:153–162.
13. Chintakanon K, Boonpinon P. Ectopic eruption of the first permanent molars: prevalence and etiologic factors. *Angle Orthod.* 1998;68:153–160.
14. Carr GE, Mink JR. Ectopic eruption of the first permanent maxillary molar in cleft lip and cleft palate children. *J Dent Child.* 1965;32:179–188.
15. Bjerklin K. Ectopic eruption of the maxillary first permanent molar. An epidemiological, familial, etiological and longitudinal clinical study. *Swed Den J Suppl.* 1994;100:1–16.
16. Barbería E, De Grado MM. Erupción ectópica del primer molar permanente superior. Revisión bibliográfica. Parte I. *Odon Ped.* 1994;3:71–76.
17. Kurol J, Bjerklin K. Ectopic eruption of the maxillary first permanent molars: familial tendencies. *ASDC J Dent Child.* 1982;49:273–279.
18. Pulver F. The etiology and prevalence of ectopic eruption of the maxillary first permanent molar. *ASDC J Dent Child.* 1968;35:138–146.
19. Canut JA, Raga C. Morphological analysis of cases with ectopic eruption of the maxillary first permanent molar. *Eur J Orthod.* 1983;5:248–253.
20. Yuen S, Chan J, Tay F. Ectopic eruption of the maxillary permanent first molar: the effect of increased mesial angulation on arch length. *J Am Dent Assoc.* 1985;11:447–451.
21. Nakata M, Wei S. *Guía Oclusal en Odontopediatria: Atlas a Color.* 1st ed. Caracas, Venezuela: Editorial Actualidades Médico–Odontológicas de Latinoamérica; 1989:14–16.
22. O'Meara WF. Ectopic eruption pattern in selected permanent teeth. *J Dent Res.* 1962;41:607–616.
23. Hotz RP. *Odontopediatría: Odontología para niños y adolescentes.* 1 ed. Barcelona, Spain: Editorial Médica Panamericana, SA; 1977:271–273.
24. Andlaw RJ, Rock WP. *A Manual of Pedodontics.* 2nd ed. Edinburgh, UK: Churchill Livingstone; 1978:138–140.
25. Heikkinen T, Alvesalo L, Osborne RH, Tienari J. Tooth eruption symmetry in functional literalities. *Arch Oral Biol.* 2001; 46:609–617.
26. Campbell OA. Ectopic eruption of the first permanent molar. *J Am Dent Assoc.* 1991;62:62–65.
27. Barbería E, De Grado VM. Erupción ectópica del primer molar permanente superior. Revisión bibliográfica. Parte II. *Odon Ped.* 1994;3:113–118.
28. Cossman MH. Ectopic eruption: first molar impaction in the mixed dentition. *Dent Dig.* 1970;76:349–353.
29. Stewart RE, Barber TK, Troutman KC, Wei SH. *Pediatric Dentistry.* 1st ed. St Louis, Mo: Mosby Co; 1982:869–870.
30. Starkey P. Infection following ectopic eruption of permanent molars: case report. *J Dent Child.* 1961;28:327–330.
31. Kurol J, Bjerklin K. Ectopic eruption of maxillary first permanent molars: a review. *ASDC J Dent Child.* 1986;3:209–214.
32. Gleerup A, Bjerklin K, Kuroll J. Discriminant analysis in treatment evaluation of ectopic eruption of the maxillary first permanent molars. *Eur J Orthod.* 1995;17:181–191.
33. Kurol J, Berjklin K. Resorption of maxillary second primary molars caused by ectopic eruption of the maxillary first permanent molar: a longitudinal and histological study. *ASDC J Dent Child.* 1982;49:273–279.
34. Baccetti T. A controlled study of associated dental anomalies. *Angle Orthod.* 1998;68:267–274.