

# Prevalence of Loss of Permanent First Molars in a Group of Romanian Children and Adolescents

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## Abstract

**Aim:** The aim of this retrospective study was to evaluate the prevalence of loss of permanent first molars in a sample of Romanian children and adolescents. **Method:** The study was performed using the records of all patients who had visited one of the authors at the Paediatric Dentistry Department of the Faculty of Dental Medicine, UMF Carol Davila, Bucharest, between 2001 and 2007. The study sample was drawn from an initial sample of 849 patients, 44 of whom had lost permanent first molars. These 44 children and adolescents, age range 8 to 17 years (median age: 13 years and 10 months) had lost 57 permanent first molars as a result of extractions. The data collected from the patients' records were statistically tested using descriptive methods as well as using multivariate techniques. **Results:** The percentage of children and adolescents with extracted permanent first molars was 5.2%. The number of patients with extraction of these teeth increased with age and the most frequently extracted molars were lower left and right first molars. The permanent first molars were mainly lost after the age of 11 years and the resulting post-extraction space rarely underwent spontaneous space closure. **Conclusions:** Just over 5% of the children and adolescents included in this study had lost permanent first molars. In the children and adolescents studied, the vast majority of permanent first molar extractions took place after the age of 11 years, too late for spontaneous space closure. The loss of permanent first molars can be avoided if good preventive measures are instigated before these teeth erupt and are continued after they have erupted.

*Key Words: Permanent First Molars Loss, Children and Adolescents, Romania*

## Introduction

Permanent first molar teeth usually erupt when a child is six years of age. They are considered to be the most important permanent teeth because of their numerous roles in the development and maintenance of the occlusion [1,2].

The important role of these teeth in the correct development of the adult dentition can be compromised by their vulnerability to dental caries and developmental structural defects which, without treatment, can lead to their progressive destruction [1,2,3,4,5,6,7].

A number of factors have to be considered when planning treatment for carious first molars. They include the degree of destruction of the crown, the extent to which the pulp has matured, the presence/absence and nature of pulpal damage, the attitude and wishes of the patient and his/her parents; all have to be considered. Treatment may

range from restoring the tooth to maintain its pulpal vitality to devitalisation and endodontic treatment, possibly followed by the provision of a crown, and to early extraction [1,2,4,7].

The negative consequences of early extraction can be prevented or reduced by establishing the optimum moment for extraction and by early orthodontic and/or prosthetic treatment of the edentulous space [2,4,7].

A number of previous studies have reported the prevalence of tooth loss in children. Al-Emran (1990) reported that the overall prevalence of missing teeth in Saudi Arabian children aged from 13.6 to 14.6 years, including extractions and trauma, was 13.6% [8]. Tooth extraction was the most common cause of tooth loss (8.6%), followed by hypodontia (4%) and trauma (1%). The mandibular first molar was the most frequently extracted tooth [8].

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A Mexican study [11] into tooth loss in a group of children aged from 7-13 years found that it was at least 7.5% and that the prevalence of lost first permanent molars was 2.1%. Loss of permanent first molars was more common (70% of all first molars lost) in the mandibular arch [9].

A recent study in the North of England reported that 8% of the 17-year-olds who were examined had had permanent first molars extracted [10].

Previous Romanian studies have reported that in 13-14-year-old children who had not received systematic (regular) dental care, the frequency of extracted or scheduled-to-be-extracted permanent first molars was between 30 and 40% [11,12].

### Aims

The aims of the present study were to evaluate:

1. The prevalence of the permanent first molar loss and its aetiology in a group of Romanian children and adolescents.
2. Post-extraction movement of adjacent and opposing teeth, taking into account the sex, age, and the time elapsed from the moment of the extraction.
3. The status of remaining permanent first molars in children who had had at least one permanent first molar extracted, compared to children with no extraction of permanent first molars.

### Methods

A cross-sectional retrospective study was carried out in the Paediatric Dentistry Department of the Dental Medicine Faculty of the UMF Carol Davila, Bucharest, Romania, using a convenience sample of all children and adolescents who had consulted and been treated by one of the authors (AMR) between 2001 and 2007.

The inclusion criteria were all healthy communicative children (older than five years and younger than 18 years) with at least one fully erupted permanent first molar.

The exclusion criteria were healthy but uncommunicative patients, patients with various mental disabilities, patients younger than the age of five years, patients with no erupted permanent first molar(s).

Intra-examiner and inter-examiner reliability tests were performed. The best intra-examiner reliability was obtained by the senior examiner (AMR), who achieved a kappa score of 0.97. It was therefore decided that she would perform all the examinations, minimising the degree of variability associated with different examiners.

Clinical examinations were performed using a dental mirror and a dental probe. Data from the clinical examination were supplemented with a history of any extractions. These histories were obtained by asking the patients concerned for their memories of the extraction(s) and from existing narratives in the patient records. The following data were also extracted from the patient records: patient's first and second names, address, age, sex, dental status (caries, fillings, missing teeth, crowns, bridges, and removable prostheses), if applicable, the date and causes of loss of permanent first molar(s) and the post-extraction consequences (continued eruption of the opposing tooth, horizontal drift of the neighbouring teeth, maintenance of the post-extraction space, its reduction or complete closure by tipping or other movement of the neighbouring teeth).

An adapted version of the International Caries Detection and Assessment System (ICDAS) [13] was used to assess the permanent first molars as:

0 = Sound.

1 = Enamel caries without cavitation (instead of first visual change in enamel and distinct visual change in enamel).

2 = Caries with cavitation (instead of localised enamel breakdown, underlying dark shadow from dentine, distinct cavity with visible dentine, extensive distinct cavity with visible dentine), where direct restorations are possible.

3 = Coronal destruction by decay, where indirect restorations are required.

4 = Where conservative treatment is no longer possible.

5 = Restoration in need of re-intervention (instead of lost or broken restoration and temporary restoration).

6 = Correct restoration (instead of tooth-coloured restoration and amalgam restoration; sealant restoration).

7 = Extracted (instead of tooth missing because of caries and tooth missing for reasons other than caries).

8 = Prosthetic treatment (instead of stainless steel crown, porcelain or gold or porcelain-fused-to-metal crown or veneer).

The post-extraction space was evaluated by visual inspection and with the use of a graduated dental probe. Apparent vertical and horizontal post-extraction movements were measured.

The children/adolescents or their parents were asked how long ago the extraction(s) had taken place.

The dependent variables in the study were the time since the permanent first molar(s) had been extracted and the consequences of the extraction(s) on the position of adjacent teeth.

Post-extraction tooth movement was assessed in terms of two variables, which were horizontal and vertical migration.

Horizontal migration was assessed as:

- Maintained space (1).
- Space diminished by horizontal tooth movement (2).
- Space diminished by tilting (3).
- Space closed (4).

Vertical migration was assessed as either extruded (over-eruption of the opposite tooth) (1) or not extruded (0).

Independent variables used in the analyses were: gender, age, time elapsed since the extraction, location of permanent first molar (upper/lower, left/right—16, 26, 36, 46) and the tooth's status (nominal discrete variable, as described previously).

The "reason for extraction" was measured on a nominal scale and limited to two possibilities: caries and molar–incisor hypomineralisation (MIH), constituting a dichotomised variable.

Data were analysed using statistical software (SPSS version 15; SPSS Inc, Chicago, USA). The chi-square test was used to assess associations.

## Results

From the initial sample of 1016 patients, 167 were excluded: 77 because they were younger than five years of age, 52 because although healthy they were uncooperative, 25 because they had no erupt-

ed permanent first molars, and 13 because they had mental disabilities. Thus the final sample was 849 patients, 422 (49.7%) girls and 427 (50.3%) boys. They were between five years and five months and 17 years and six months old (median age 13 years 10 months).

A total of 44 children (5.2%) from the sample had missing permanent first molars and a total of 57 permanent first molars were missing, representing 1.71% of the total number of permanent first molars in the overall sample. Thus 32.7% of all permanent first molars had been extracted in the 44 children and adolescents who made up the sample.

The mean age of the children and adolescents with missing first molars was 11.3 years (SD=3.51 years) and the median age was 10.6 years (range 5.2–17.9 years). The age distribution of the children with extracted permanent first molars can be seen at *Figure 1*.

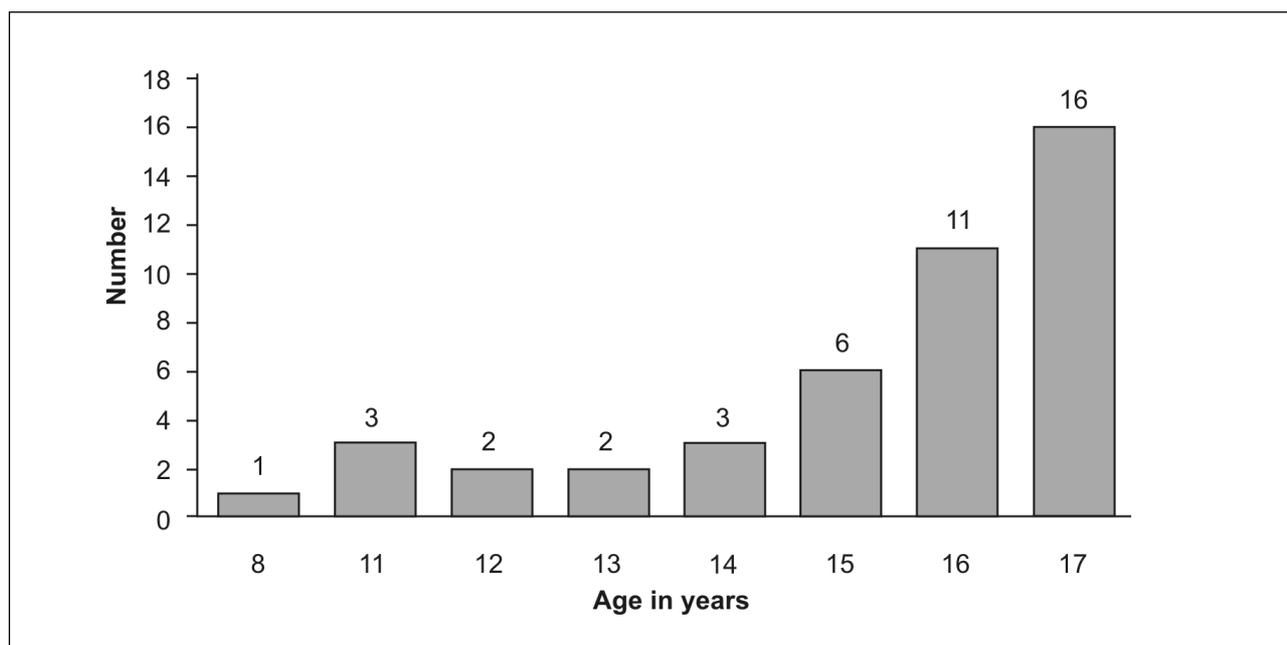
Eleven children presented with more than one extracted permanent first molar, of whom six were girls (five with two extracted molars and one with three) and five boys (four with four extracted molars and one with three) (*Table 1*).

Fifty (87.7%) of permanent first molars were lost due to dental caries and seven (12.35) were lost due to MIH.

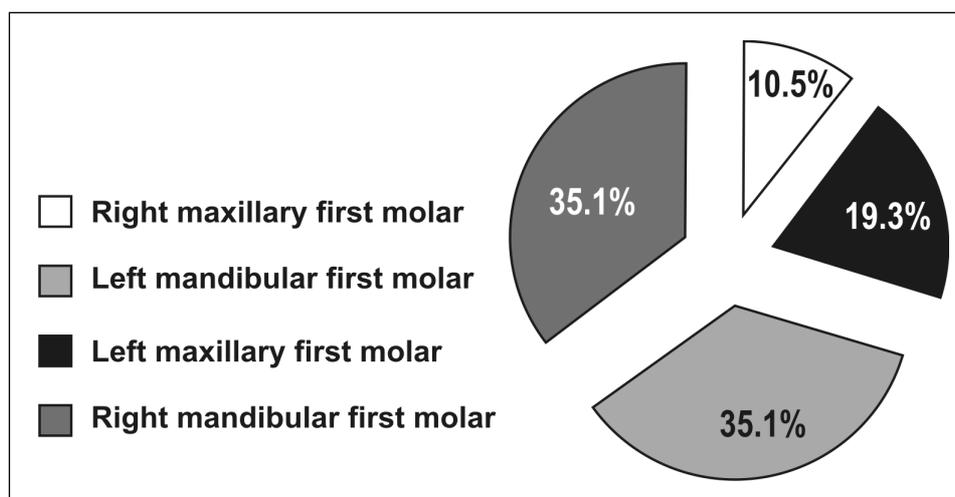
Forty (more than 70%) of the extracted permanent first molars were from the mandible, of which 20 (35.1%) were lower left and 20 (35.1%) were lower right permanent first molars. In the maxilla, nearly twice as many upper-left permanent first molars (11-19.3%) had been extracted as upper-right permanent first molars (6-10.5%) (*Figure 2*). A chi-square test indicated that the higher incidence of extractions for mandibular molars was statistically highly significant ( $P<0.0001$ ).

**Table 1.** Distribution of Children With Missing Permanent First Molars

	Number of permanent first molars extracted	% of total examined
Total affected	44	5.2
		% of affected cases
One tooth missing	33	75.0
Two teeth missing	9	20.5
Three teeth missing	2	4.5
Mean number missing per child	1.3	
		% of total number of missing teeth
Missing from mandible	40	70.2
Missing from maxilla	17	29.8



**Figure 1.** The age distribution of the children with extracted permanent first molars.



**Figure 2.** Distribution of loss of permanent first molars by quadrant.

**Table 2.** Carious Experience of Permanent First Molars Using the Modified ICDAS Codes

ICDAS Code	Molars in patients with missing permanent first molars	Molars in patients without missing permanent first molars
0	3.4% (n=6)	27.7%
1	6.8% (n=12)	19.3%
2	33% (n=58)	40.9%
3	1.7% (n=3)	0.9%
4	7.4% (n=13)	2.5%
5	9.1% (n=16)	3.2%
6	6.3% (n=11)	5.5%
7	32.3% (n=57)	0%
8	-	-

**Table 3.** Modification of the Post-Extraction Space Related to the Age of the Patient When the Permanent First Molar was Lost

	Maxilla		Mandible	
	Favourable*	Unfavourable**	Favourable*	Unfavourable**
9-10 years			7	1
10-11 years	1			
11-12 years	1		1	
12-13 years				1
13-14 years		1		5
14-15 years		3		1
15-16 years		1		9
16-17 years				1
17-18 years				1

\*Horizontal corporeal migration; complete space closure

\*\*Tilting, extrusion of the antagonist tooth

The carious experience of permanent first molars still present in the mouths of patients who had had other first molars extracted was higher than in patients with no permanent first molar loss.

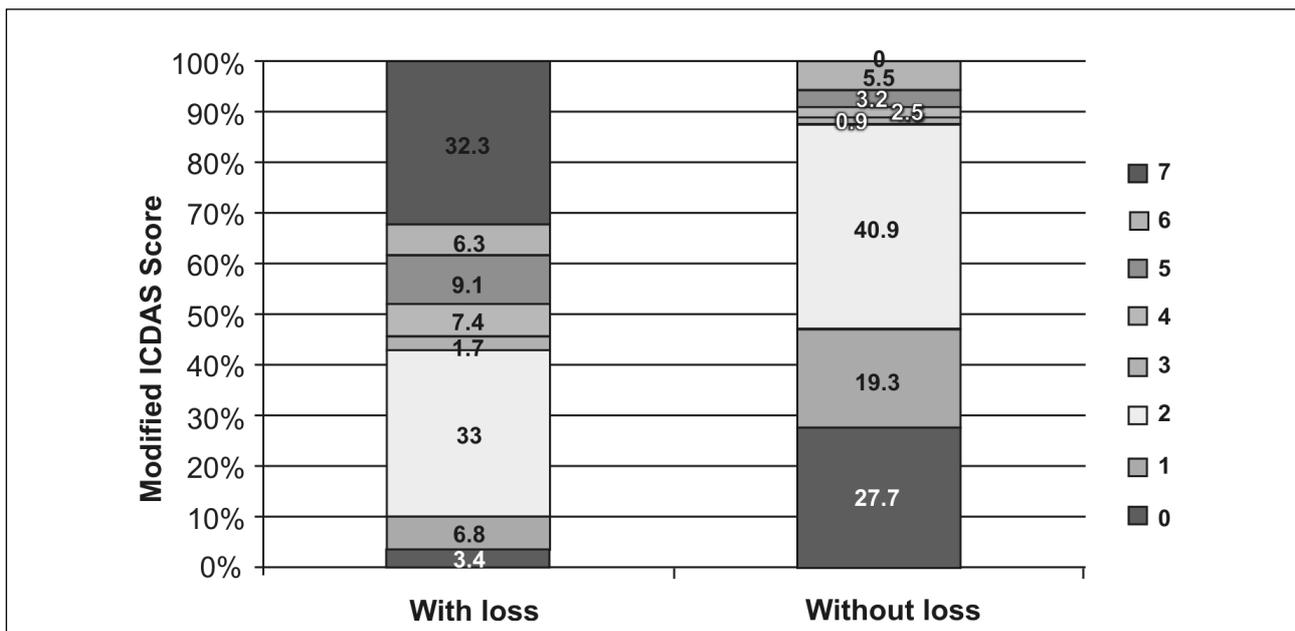
The results of the evaluation of caries experience in permanent first molars as assessed with the modified ICDAS codes are presented in Table 2.

Caries was present in 58 (33%) permanent first molars in the 44 patients who had had previous permanent first molar extractions, whereas it was present in 40.9% of the permanent first molars of the 805 patients without previous first molar extractions.

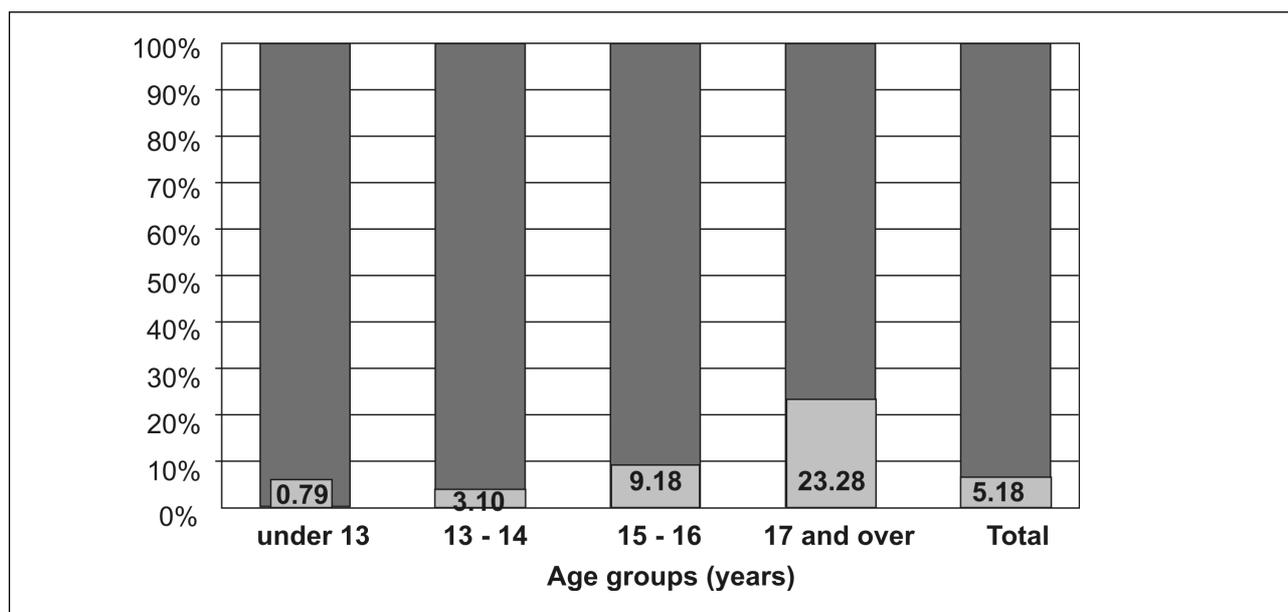
The percentage of healthy (caries-free) permanent first molars in patients who had had permanent first molar extractions (3.4%) was lower than in patients without permanent first molar extractions (27.7%) (Figure 3).

Post-extraction migration occurred as follows:

- Over-eruption of opposing teeth: 12 occurrences (21.1%).
- Horizontal migration of the neighbouring teeth: 22 occurrences (38.6%).
- Space reduced by tipping: 12 occurrences (21.1%).



**Figure 3.** Percentages of all molar teeth in the different modified ICDAS Codes in children with and without loss of permanent first molars.



**Figure 4.** The frequency of permanent first molar loss by age groups (%).

- Space reduced by translation: 7 occurrences (12.3%).
- Space completely closed: 3 occurrences (5.3%).
- Dual drift (horizontal and vertical): 2 occurrences (3.5%).

Very slightly more girls (22 of 422; 5.2%) than boys (22 of 427; 5.1%) had lost permanent first molars. This was no statistically significant difference when the chi-square test was applied.

The frequency of permanent first molar loss by age in the groups (under 13; 13-14; 15-16; and 17 and over years) is presented in *Figure 4*. Unsurprisingly, it increased with age.

Post-extraction space appeared to be more frequently maintained in the mandible than in the maxilla. Nevertheless, because of the relatively low numbers of maxillary permanent first molar extractions, proportionally there was no difference. Space was maintained after three (50%) upper-right first molar extractions and after ten (50%) lower-left permanent first molar extractions and after eight (75%) upper-left permanent first molar extractions and after 14 (75%) lower-right permanent first molar extractions. There was no statistically significant difference ( $P=0.57$ ).

Post-extraction horizontal migration (drifting) occurred after 31 of the 57 extractions (54.6%). Its occurrence increased with the age of the patient and unsurprisingly was commonest in those aged 17 years. The location of the permanent first molar extractions (maxillary or mandibular) had no statis-

tical influence ( $P=0.11$ ) on the occurrence of horizontal migration, neither did gender ( $P=0.65$ ).

Similarly, vertical drifting (over-eruption) was seen to occur more frequently in patients from older age groups: in six (50%) from the 15-16 years group and in six (50%) of the 17 years and older group. In total, vertical drifting (over-eruption) occurred in 12 patients and horizontal drifting (migration) in 22 patients.

Continuous tooth eruption was encountered more frequently when the extraction was performed in the mandible ( $P=0.02$ ). The appearance of spontaneous vertical migration was not influenced by the patient's gender ( $P=0.58$ ). Spontaneous vertical migration of the tooth opposing an extracted permanent first molar appeared at least one year after the extraction.

The age at which a permanent first molar extraction occurred had a significant influence on post-extraction tooth positioning in both maxillary ( $P=0.02$ ) and mandibular ( $P<0.001$ ) arches. Data concerning the modifications of the post-extraction space are presented in *Table 3*.

Most of the favourable modifications ( $n=7$ ) following a permanent first molar extraction in the mandible occurred before the age of 10 years. The only patients with the complete closure of the post-extraction space in the mandible were younger than 10 years at the time of the extraction.

In the maxilla, although data are insufficient to obtain a statistically valid conclusion, it seemed that favourable evolutions of the post-extraction space extend until the age of 12 years.

### Discussion

Although the initial sample of over 1000 patients was large, the number with missing permanent first molar teeth was relatively small and even smaller when they were subdivided by age and gender. There may also be doubts about whether or not the sample children were representative of all children in Bucharest and Romania. The results obtained in this study must be viewed in the light of these considerations.

The percentage of children who had experienced the extraction of permanent first molars and the frequency of the loss of these teeth was slightly lower in the current study than in previous ones [8,9,10,11,12]. However, valid comparison cannot be made as the age groups are not comparable. In the current study, patients had a wide age range.

One strength of the study is that the examination of all the patients was performed by a single calibrated examiner, who obtained the best rating of the intra- and inter-examiner reliability tests, and thus we minimised the degree of variability associated with different examiners.

Another feature of the study was the opportunity to assess the prevalence of extractions and sequelae over a number of years.

A weakness of the study was the possibility of errors in the assessment of the post-extraction spatial dimension as this was by clinical methods only, without any radiological evaluation or from dental casts. This was because the study was retrospective and it would have been unethical to take radiographs years after the extraction of the permanent first molars just to assess space loss. Further studies are planned which will be longitudinal and performed on a representative sample of patients.

Another potential weakness may be the reliability of the information obtained regarding the date of the extractions, because it often depended on the answers given by patient/parents, which may have been imprecise. This situation is inherent to this type of study and could have been avoided only if all the extractions had been performed in our clinic.

An association between gender and prevalence of loss of permanent first molars could not be statistically established. However, as expected, this prevalence increased with the age of the patients. The finding that there had been a higher proportion of permanent first molar extractions in the

mandible confirmed the findings of other studies [8,9]. Possible reasons for this may be the earlier eruption of the mandibular molar and its higher caries-risk due the complex occlusal fissure system that predisposes to bacterial plaque accumulation.

Previous studies have indicated that in order to minimise negative consequences following permanent first molar extraction and to obtain space closure by subsequent drifting of the teeth, it is necessary to perform the extraction(s) at an optimal time. This has been suggested by one study to be 8.5-10 years in the mandible and as late as 10-11.5 years in the maxilla [15] and to be less than 10 years of age by another study [6]. Although the present study did not assess the ideal moment of extraction, its results confirm that the only patients who presented with complete closure of the post-extraction space in the mandible were younger than 10 years when their permanent first molars were extracted. This result supports the findings of Jälevik and Möller (2007), who assessed favourable spontaneous space reduction and development of the permanent dentition and found that it can be expected without any intervention in the majority of cases extracted prior to the eruption of the second permanent molar [17].

Although relatively few patients who had lost permanent first molar teeth were assessed in the present study, the finding of a greater prevalence of post-extraction horizontal rather than vertical migration was in conflict with that of at least one previous study, which found that over-eruption of the opposing tooth was the main consequence of the loss of the permanent first molar [18]. However, in the present study the patients concerned came from a far wider age range.

### Conclusions

Just over 5% of the children and adolescents included in this study had lost permanent first molars. This was probably due to the fact that these teeth erupt earlier than any other permanent teeth, other than lower incisors, and are therefore exposed to the rigours of the oral environment for a longer period of time. In the children and adolescents studied, the vast majority of permanent first molar extractions took place after the age of 11 years, too late for spontaneous space closure. The loss of permanent first molars can be avoided if good preventive measures are instigated.

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