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Evaluation of spontaneous space closure and development of permanent dentition after extraction of hypomineralized permanent first molars

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Aim. The aim of this study was to evaluate spontaneous space closure, development of the permanent dentition, and need for orthodontic treatment after extraction of permanent first molars due to severe molar–incisor hypomineralization (MIH).

Subjects. Twenty-seven children aged 5.6–12.7 (median 8.2) years had one to four permanent first molars extracted due to severe MIH. Each case was followed up on individual indications 3.8–8.3 (median 5.7) years after extractions.

The eruption of the permanent dentition, and space closure were documented by orthopantomograms, casts, photographs, and/or bitewings.

Results. Fifteen children were judged to have a favourable spontaneous development of their permanent dentition without any orthodontic intervention. Seven children were or should be subjected to orthodontic treatment for other reasons registered prior to the extraction. Five children were judged to have a treatment at least caused by the extractions, but three of them abstained because of no subjective treatment need.

Conclusion. Extraction of permanent first molars severely affected by MIH is a good treatment alternative. Favourable spontaneous space reduction and development of the permanent dentition positioning can be expected without any intervention in the majority of cases extracted prior to the eruption of the second molar.

Introduction

Hypomineralized permanent first molars, often in combination with hypomineralized incisors [molar–incisor hypomineralization (MIH)][1], are common (3.6–19.3%) in many child populations[2–5]. The severely affected molars often show disintegration of the enamel in the occlusal parts[6] and require extensive treatment[4]. These teeth create problems both for the patients and for the dentists. Children often report shooting pain when they are brushing their teeth or even breathing cold air often shortly after the eruption of the affected teeth has started. The severely affected teeth are soon in need of restoration due to disintegrating enamel and subsequent caries[7].

The treatments can be painful due to difficulties in anaesthetizing. The prismatic morphology in the porous enamel is altered[6], making bonding hazardous, and a substantial amount of defective fillings and need of retreatment in MIH teeth have been reported[8–11]. As a consequence of repeated painful treatments, children with severe MIH have been reported to display more behaviour management problems and more dental fear and anxiety[8]. In cases with extensive disintegration, troublesome hypersensivity, and/or increasing dental anxiety, the extraction of the tooth might be the therapy of choice.

From the orthodontists' point of view, there have been conflicting opinions about the benefit of extracting permanent first molars with poor prognosis and there is little evidence for the rationale of the timing and extraction pattern for the first permanent molar[12]. The opinions about first-molar extraction range between the unbridled enthusiasm expressed by Wilkinson[13] to the great scepticism expressed by Mill[14]. Thilander and Skagius have reported that the best results were found when extractions were performed during 8–10 years of age.

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Crowding in the relevant quadrant was also found to be favourable for a good orthodontic result as well as presence of the third molar[15]. Mandibular first-molar extraction might also increase the space for mandibular third-molar eruption and helps the third molars move to better position[16]. Furthermore, it has been shown that early loss of permanent first molars might have an accelerating effect on development of the third molar on the extraction side[17]. Williams and Gowans[12] recommended considering compensating extraction of the opposing maxillary permanent first molar when extracting the mandibular permanent first molar. Furthermore, in case of crowding in the mandibular arch they strongly recommended considering balancing extraction of the contra-lateral lower permanent first molar.

The aim of this study was to evaluate the development of the permanent dentition and need for orthodontic treatment after extraction of permanent first molars due to severe MIH.

Materials and methods

A total of 33 children who had one to four first permanent molars extracted due to severe MIH and poor prognosis were eligible for this follow-up evaluation. These cases have previously been reported in a study analysing histo-morphology of teeth with MIH[6]. The children were the patients consecutively referred to Specialist Clinic of Pedodontics, Sahlgrenska University Hospital, Mölndal, and to the Department of Pedontontics, Faculty of Odontology, Göteborg University, in October 1996 to January 1999 due to severe MIH. In all cases, difficulties in performing lasting filling therapy and/or continues sensitivity in these teeth were reported. In agreement with the orthodontists, a more radical treatment option was decided implying extraction the troublesome teeth. Exclusion criteria for extraction therapy were general spacing and/or agenesis of permanent teeth in the quadrant concerned with exception of third molars. It was not possible to judge if the child had third molars or not before the age of nine approximately. If pre-normality, extraction therapy was avoided in the upper jaw unless the opposite lower molar was extracted. If post-normal relation, extraction therapy was avoided in the lower jaw unless the opposite upper molar was extracted.

Three children (cases 5, 9, and 14) had orthodontic treatment directly after the extractions and therefore the spontaneous bite development could not be evaluated. All three had lower first permanent molar(s) extracted after the eruption of the second molars, i.e. late extraction (11.6 to 14.4 year olds). Those cases are shown in Table 1 in italics. As further three of the patients had migrated, the follow up was based on 27 children (15 girls and 12 boys), where eruption and development of the permanent dentition was followed.

After the extractions, the development was followed and the need for orthodontic treatment was judged. Each case was followed after individual indications, and the development was documented by orthopantomograms, casts, photographs, and/or bitewings.

The median age at the time of extraction for 27 children was 8.2 year (range 5.6–12.7). The median follow-up time was 5.7 year (range 3.8–8.3). The children each had an average of 2.6 molars extracted. The distribution is shown in Table 1.

Evaluations of development of the permanent dentition were performed by the authors, a specialist in orthodontics (MM), and a specialist in paediatric dentistry (BJ). Criteria for good or favourable bite development were spontaneous space reduction, no tilting of teeth that could make oral hygiene more difficult, no teeth elongation in the opposite jaw, and patient satisfaction.

Results

Patient material, number of first molars extracted, age at extractions, and need of orthodontic treatment are shown schematically in Table 1.

Orthodontic treatment

Fifteen children were considered to have a favourable bite development without any orthodontic intervention (Figs 1 and 3b,c). Three children (cases 5, 9, and 14) had orthodontic treatment directly after the extractions and therefore the spontaneous bite development

Table 1. Patient material by gender, age at extraction, and evaluated need for orthodontic treatment at follow up.

Patient no.	Gender	Age at extraction (year)	Age at evaluation (year)	Extracted teeth				Good bite development without intervention	Need for orthodontics not related to extraction(s)	Need for orthodontics caused by extraction(s)	Need for orthodontics, extraction(s) partly involved
				16	26	36	46				
1	F	8.8	15.9	x	x	x	x	Yes			
2	F	11.1	16.2	x	x				Yes		
3	M	8.4	15.0				x	Yes			
4	M	12.3	16.7			x		Yes			
5	F	13.1	19.0	x	x	x	x			Yes†	
6	M	10.3	16.3	x	x	x	x	Yes			
7	F	6.9	13.2		x			Yes			
8	F	8.7	13.7		x				Yes		
9	F	14.4	18.9		x	x					Yes†
10	F	7.5	13.2	x				Yes			
11	F	7.2	12.9		x			Yes			
12	F	7.9	12.1	x	x	x	x	Yes			
13	M	12.7	16.9		x	x	x		Yes		
14	F	11.6	16.0			x				Yes†	
15	M	7.7	13.1	x	x			Yes			
16	F	9.6	14.6	x	x	x	x				Yes
17	F	8.2	13.8	x	x	x	x	Yes			
18	F	8.3	12.2	x	x	x	x	Yes			
19	M	8.2	12.7		x	x	x			Yes‡	
20	M	8.9	13.8	x					Yes		
21	M	8.7	13.6		x			Yes			
22	M	5.6	13.9	x	x	x	x		Yes		
23	F	6.8	13.9	x	x	x§				Yes	
24	F	6.2	12.9	x	x	x		Yes			
25	M	8.4	15.2	x	x	x	x		Yes		
26	F	7.8	15.3	x	x	x	x			Yes‡	
27	F	6.9	13.4	x	x	x		Yes			
28	F	7.9	15.3	x	x	x	x				Yes‡
29	M	8.1	13.6				x		Yes		
30	M	9.5	15.3	x	x			Yes			

†Orthodontic treatment directly after the extraction.
‡Abstained from orthodontic treatment.
§Extracted at 11.9 years of age.

could not be evaluated. They all had lower first permanent molar(s) extracted after the eruption of the second molars, i.e. late extraction (11.6 to 14.4 year olds). Seven children were or should be subjected to orthodontic treatment for other reasons, e.g. crowding of fronts as well as crossbites, or distal bites (Fig. 2) registered prior to the extraction. Two children (cases 16 and 28) were offered treatment for orthodontic problems partly due to the extractions. Case 16 had esthetical problems with irregular upper front teeth and peg-shaped laterals. Case 28 had open bite on the right side due to abnormal swallow pattern. Beside that, she also had mesial inclination of the lower second molar and some distal inclination of lower second premolar on this side due to extraction of the first molar. One of these patients (case 28) abstained from orthodontic treatment because of no subjective treatment need. Three were offered orthodontic treatment to correct gaps, spacing, or deficiencies in occlusion caused by the extractions. Two of them (cases 19 and 26) abstained from orthodontic treatment because of no subjective treatment need. The third child (case 23) had a lower permanent first molar extracted at late age. This case (23) is of particular interest. She had her two upper first molars extracted at the age of 6.8 years. It was also decided to extract the left lower first molar, but the orthodontic consultant recommended postponing the extraction until the second lower molar was beginning to erupt in order to get optimal spontaneous

Fig. 1. Case 17. Tooth eruption and positioning in a girl having all permanent first molars extracted at the age of 8.2 years.

Fig. 2. Case 13 had 26, 36, and 46 extracted at the age of 12.7 years. Crossbite on both sides, frontal open bite, and crowding were registered prior to extractions.

space closure. The tooth was extracted at 11.9 years of age (Fig. 3a). Two and a half years later, the girl was referred to orthodontic treatment because of remaining gap, and mesial as well as lingual tilting of the lower second molar. Two other girls (cases 24 and 27) had the same teeth (16, 26, 36) extracted, all teeth before the age of seven. They had a good spontaneous bite development (Fig. 3b,c)

Space closure, inclination of adjacent teeth, and centreline shift

About two-thirds of the children had good spontaneous space closure after the extractions with no or minor remaining gaps (Figs 1, 2 and 3a,b). Every tenth child had gaps and every fifth had spacing in the involved quadrants after extraction (Fig. 4).

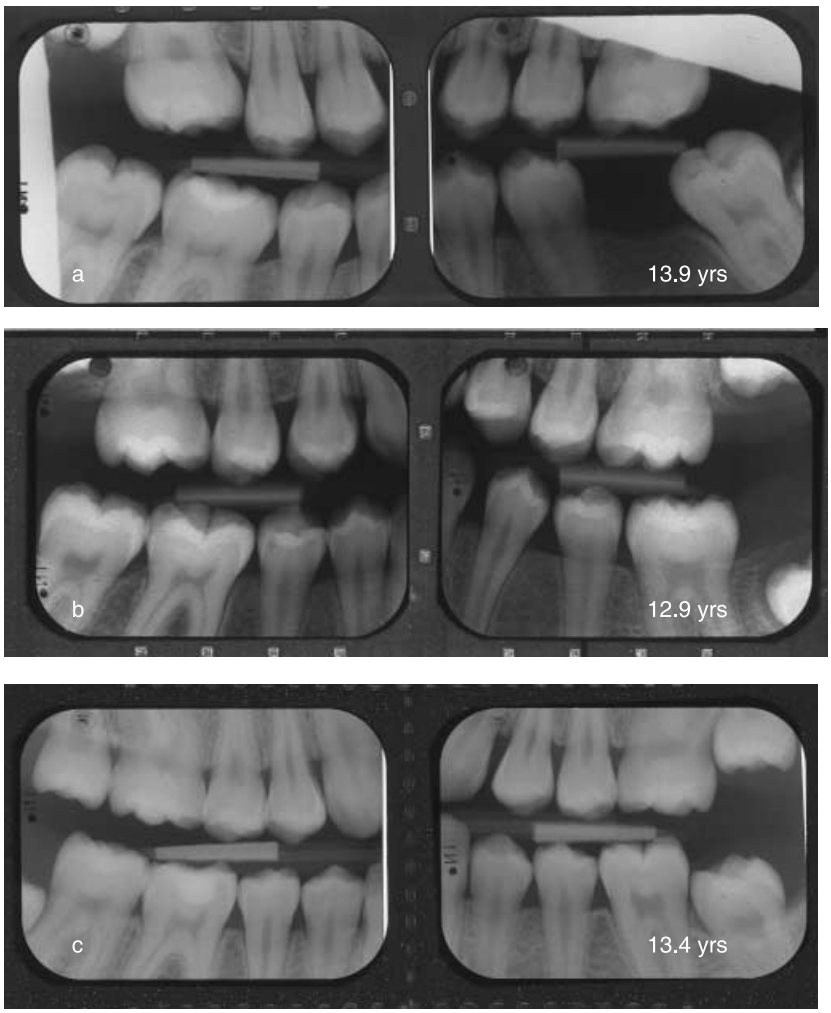

Fig. 3. (a) Case 23 had 16 and 26 extracted at 6.8 years of age, 36 extracted at 11.9 years of age. (b) Case 24 had 16, 26, and 36 extracted at 6.2 years of age. (c) Case 27 had 16, 26, and 36 extracted at 6.9 years of age.

Fig. 4. A 15-year-old boy (case 3) who had his right lower permanent first molar extracted at the age of 8.5 years. In the affected quadrant there are some general spacing and also slight tilting of the second molar mesially and the premolars distally.

Mesial inclination of the second molar was seen in about two-thirds of the children. However, in all cases but four, the inclination was minor, and in no case there was a severe tilting. Tilting was more common in the lower jaw (Figs 1 and 4). The bicuspids had drifted somewhat distally in less than one-third of the cases that had lower first molar(s) extracted. In three of these cases (3, 6, and 28), there was also a slight distal tilting of the bicuspids.

Distal inclination of the tooth germ of the second bicuspid before eruption is characteristic for these cases (Fig. 4). In any of these cases, impaction of a second premolar was seen.

In four children (cases 3, 4, 13, and 19), a lower first molar was extracted but not the upper opposite first molar (Figs 2 and 4). They all had a favourable development. In two of those cases (13 and 19), the upper opposite first molar was extracted on one side but not on the other (Fig. 2). The bite development was not more favourable on either side.

When extraction was performed in the upper jaw and not in the lower, a common situation, the bite development was still good.

In no case, we revealed unfavourable centreline shift that could be derived from a unilateral extraction.

Presence of third molars

Three cases (12, 21, and 26) had all third molars missing and two cases (8 and 18) had two third molars missing. Seventy-nine per cent of the exactions had been performed in a jaw half with a third molar present.

Discussion

This study has shown that extraction of permanent first molars severely affected by MIH can be a good treatment option. Preferably, the extractions should be planned in collaboration with an orthodontist, before the eruption of the second permanent molar.

The extraction of permanent first molars has been controversial for a long time[12,18]. However, in the latter half of the last century, orthodontists took a more positive attitude to extraction of the permanent first molars. The extraction of permanent first molars severely affected by MIH draws conflicting opinions between the paediatric dentists and more conservative orthodontists. The paediatric dentists have to perform technically complicated fillings in a child with increasing dental anxiety and behaviour-management problems[8], whereas the orthodontists may want to preserve the importance of keeping permanent first molars.

This follow-up study shows favourable spontaneous development of the permanent dentition after first-molar extraction in the majority of cases.

Twelve children were offered orthodontic treatment but seven of them (26% of the whole group) had common orthodontic problems as crowding, crossbites, and distal bites which not could be related to the extractions. The orthodontic treatment besides first molars extraction was in accordance with a recent systematic literature review which reported that the need for orthodontic treatment in the Swedish population was 27%[19]. The remaining five children were offered orthodontic treatment for reason which could be related to extractions. In one case (23), the extraction of a lower first molar had been postponed because the dentist had waited for the second molar to erupt. Case 26 had agenesis of all third molars and case 19 had not the tooth germs of the third molars visible until 11 years old. These findings are in accordance with Thilander and Skagius, who found the best result when extractions were performed at 8–10 years of age and when the third molars were present[15]. The remaining two children (case 16 and 28) had, as mentioned before, besides spacing, respectively, tilting caused by the extractions and other complicating orthodontic problems. Remarkable, only two of those five children had a subjective treatment need.

Earlier extractions of, especially, lower permanent first molar were not recommended because of risk of the lower second premolar tilting and drifting distally[12]. This fear was not verified in the present study. Instead, all cases that had a lower and/or upper first molar extracted at an early age had a good spontaneous development.

A clinical dilemma is if compensating extraction of an opposing healthy first molar or balancing extraction of a contra lateral healthy first molar ought to be carried out. Williams and Gowans recommend considering compensating extraction of an upper molar when you extract the opposing molar to avoid elongation. As a preventive measure in avoiding centreline shift, they recommend considering balancing extraction of an upper as well as a lower molar when extracting the contra lateral molar[12]. In this follow up, uncompensated and unbalanced extractions were performed. In

spite of this, there was a good spontaneous occlusal development. Therefore, you can assume that compensating and/or balancing extraction is not always beneficial when extracting a permanent first molar.

Recent studies have shown that you can expect earlier development and better positioning of the third molar when extracting the first molar[16,17]. As the majority of the extractions in this study were performed in quadrants with third molars present you can expect an earlier eruption and fewer problems with the third-molar impaction as a favourable side-effect.

In conclusion, spontaneous space reduction and favourable development of the permanent dentition can be expected when extracting a severely hypomineralized permanent first molar prior to the eruption of the second permanent molar.

What does this paper adds

- Good spontaneous space closure can be expected when extracting a permanent first molar prior to eruption of the permanent second molar.
- Extraction of a permanent first molar with bad prognosis could be a good treatment alternative.

Why this paper is important to paediatric dentists

- Paediatric dentists often meet children who suffer great pain as a result of seriously hypomineralized permanent first molars.
- Early extraction of teeth affected by MIH may prevent future dental problems.

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