

## IN BRIEF

- Caries is the main reason for the extraction of first permanent molars in children.
- Children who are attending dental hospitals for extraction of first permanent molars tend to be older than the optimal age for achieving space closure.
- There is a need for guidelines advising primary care dentists when to refer children for the extraction of first permanent molars.
- This study highlights the need for extensive prevention programmes targeted at those children with high caries risk.

# Extraction of first permanent molar teeth: results from three dental hospitals

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**Objective** To evaluate and compare the reasons for and pattern of extraction of first permanent molars (FPMs) in three UK dental hospitals.

**Design** Prospective multicentre study.

**Setting** Hospital.

**Subjects** Three hundred children attending Manchester Dental Hospital, Liverpool Dental Hospital and Charles Clifford Dental Hospital (Sheffield) who required extraction of at least one FPM.

**Result** The mean age in months was 129 (SD 22.7), 139 (SD 29.4), and 133 (SD 26.8) for Manchester, Liverpool and Sheffield respectively. Forty-five percent and 48% of children had four FPMs extracted at Manchester and Sheffield respectively, compared to 25% in Liverpool. The main reason for extraction was caries with poor prognosis (70%); molar incisor hypomineralisation was the reason for extraction in 11% of cases. General anaesthesia was the main anaesthetic method used in 77%, 55%, and 47% of cases in Manchester, Liverpool and Sheffield respectively. Sixty-eight percent of cases had not received previous treatment for the FPMs and 5% had fissure sealants detected. Forty percent of children had had previous extractions.

**Conclusion** The children who are attending the hospitals for extraction of FPMs tend to be older than the recommended age for achieving spontaneous space closure. This study highlights the need for extensive prevention programs targeted at those children with high caries risk.

## INTRODUCTION

The first permanent molar tooth (FPM) has been quoted as the most caries-prone tooth in the permanent dentition.<sup>1</sup> In 2003, 43% of 12-year-old children in the UK had some caries experience.<sup>2</sup> In addition, 10-19% of children have some form of hypomineralised FPM as part of a condition known as molar incisor hypomineralisation (MIH).<sup>3-6</sup>

Extraction of FPMs with poor prognosis has been advised in the orthodontic literature.<sup>7,8</sup> However, there are many factors that should be considered when treatment planning for patients with grossly carious FPMs.<sup>9</sup> The ideal time for the loss of a FPM is with the commencement of calcification of the bifurcation of the second permanent molars,<sup>10</sup> which usually occurs at a chronological age of eight to ten years.<sup>11,12</sup> This should facilitate mesial movement of the second permanent molar into the FPM area when hopefully a good contact will be established with the second premolars.<sup>7</sup> Earlier extraction before the age of eight years might result in distal drifting and rotation of the unerupted second premolar, especially in the spaced dentition or when there has been early loss of the second primary molar.<sup>13</sup> Conversely, late extraction (ie during or after the eruption of the second permanent molars) will result in an unsatisfactory space closure.<sup>7</sup>

There is a widely held opinion advocating compensating extraction of the upper FPM when loss of the lower FPM is planned.<sup>14</sup> This is to avoid the potential for over-eruption of the upper FPM preventing mesial movement of the lower second permanent molar. There is, however, little supporting data in the literature.<sup>15</sup> The presence of third molars should also be considered.<sup>9</sup> Knowledge about the outcome of extraction of FPMs in relation to age is still based upon clinical experience and expert opinion.<sup>12,15</sup>

An assessment of the developing dentition should be undertaken before extraction of first permanent molars. Factors such as dental pain, parental attitudes and the ability of the child to tolerate treatment under local anaesthesia may influence the

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decision to restore or extract FPMs.<sup>12</sup> In addition, the majority of children who require extraction of FPMs because of caries have generally poor oral health and are poor candidates for future orthodontic treatment.<sup>14</sup>

There are very few data regarding the reasons for and the pattern of extraction of FPMs. The aim of the present study was to evaluate and compare the reasons for and pattern of extraction of FPMs in three UK dental hospitals. Further objectives were to identify any previous treatment carried out on FPMs, record previous dental extractions and determine if an orthodontic assessment by a consultant in paediatric dentistry or an orthodontist had been undertaken.

**SUBJECTS AND METHOD**

Data for this study were collected on 300 children who required extraction of at least one FPM at Manchester Dental Hospital, Charles Clifford Dental Hospital (Sheffield) and Liverpool Dental Hospital; 100 children were included from each of the centres.

Demographic information recorded included date of birth, date of assessment, gender and whether the patient was a regular or irregular dental attendee. A regular dental attendee was defined as a patient who was reported to be registered with a dentist and attended most of their appointments (treatment and/or check ups) with a minimum of one dental visit in the past 12 months.

The FPMs extracted were noted. The reasons for extraction were recorded as follows: caries with poor prognosis, MIH, balancing and compensating extraction. Type of anaesthesia used (general anaesthesia [GA], local anaesthesia [LA], or LA with nitrous oxide inhalation sedation [IS]) was also recorded. Previous treatment to the FPM was listed as none, fissure sealant,

**Table 1 The number of first permanent molars (FPMs) extracted in the three centres**

Number of FPMs	Hospital		
	Manchester	Liverpool	Sheffield
1	24	37	26
2	25	34	26
3	6	4	0
4	45	25	48

Chi-square = 18.6; p = 0.005

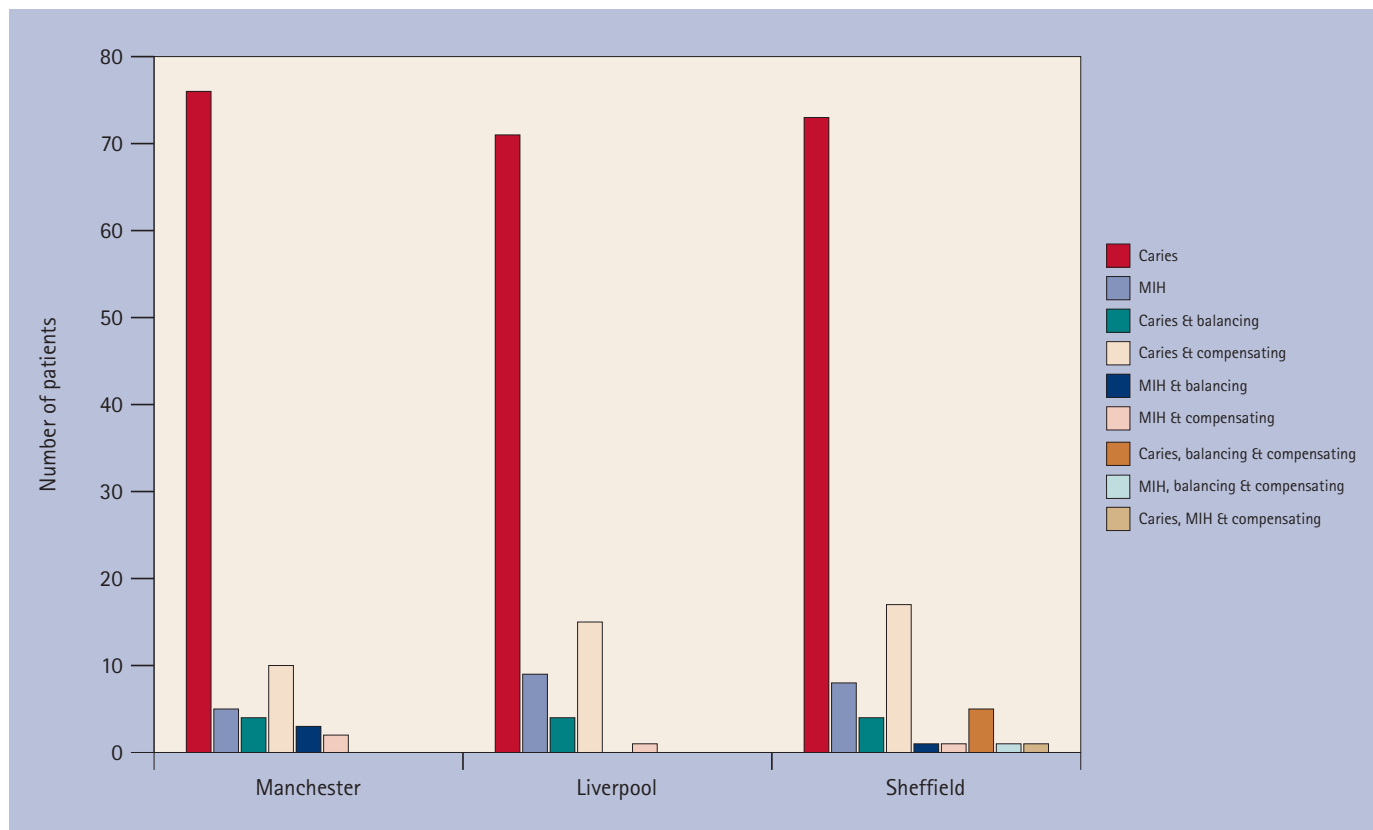
**Table 2 The mean age of the children in months (SD) and the number of FPMs extracted**

Number of FPMs (n)	1 (87)	2 (85)	3 (10)	4 (118)
Mean age (SD)	143.0 (28.4)	134.8 (27.1)	135.1 (27.7)	125.4 (22.8)

temporary restoration, permanent restoration, stainless steel crown or root canal treatment.

The children's incisal relationships were recorded as class I, class II or class III.<sup>16</sup> The presence or absence of premolar crowding was noted, together with any congenitally absent premolars as detected radiographically. Data were also collected regarding previous extractions, the number of teeth extracted, the method of extraction and the place where this was undertaken.

Chi-square tests were used to compare relative differences in the numbers of FPMs extracted and attendance, centre and



**Fig. 1 The reasons for extractions of first permanent molars in the three centres**

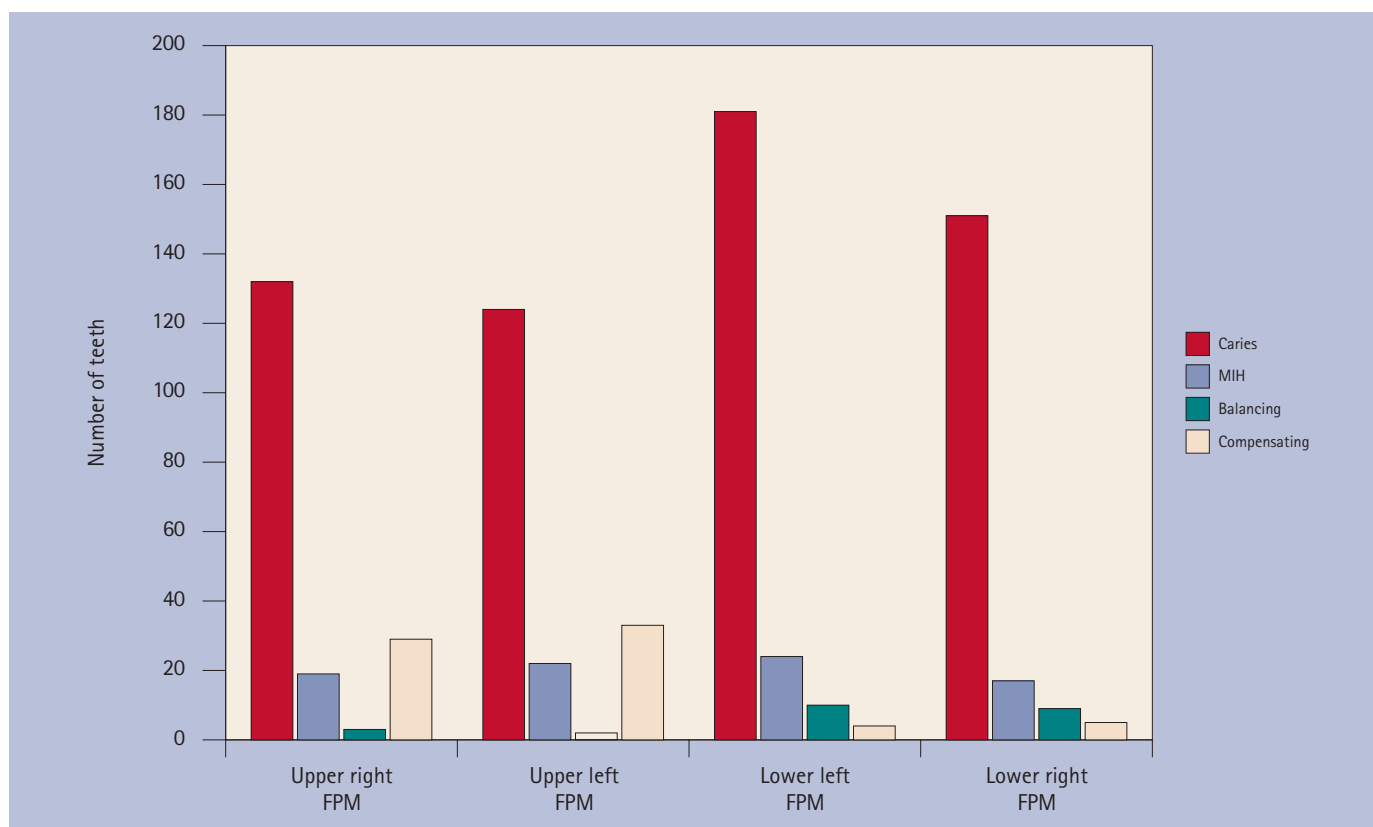


Fig. 2 The reasons for extraction of first permanent molars on a tooth basis

the anaesthetic used. One-way ANOVA was used to compare the mean ages of children having different numbers of FPMs extracted and the anaesthetic used.

## RESULTS

The mean age in months was 129 (SD 22.7), 139 (SD 29.4), and 133 (SD 26.8) for Manchester, Liverpool and Sheffield respectively. Male to female ratio was 1:1.3, 1.3:1 and 1.1:1 in Manchester, Liverpool and Sheffield respectively. Sixty-two percent of the children who attended Manchester were classified as regular attendees compared to 46% in Liverpool and 41% in Sheffield. No differences were found between the number of FPMs extracted and the pattern of attendance ( $p = 0.514$ ).

Table 1 shows the number of FPMs extracted in the three centres. A statistically significant difference was found among the proposed extractions ( $p = 0.005$ ), with just under half of the patients in both Manchester and Sheffield having all FPMs removed, while 25% of the cases in Liverpool had all four FPMs extracted.

Table 2 demonstrates the relationship between the number of FPMs proposed for extraction and the mean age. A statistically significant difference was found between the children's age and the number of teeth extracted ( $p = 0.000$ ,  $F$ -ratio = 7.849).

Figure 1 shows the reasons for extraction of FPMs in the three centres. Caries with poor prognosis was the main reason for extraction in the vast majority of cases in all centres ( $n = 268$  [89%]). MIH was the main reason for 32 (11%) cases. Balancing extractions were carried out in 23 cases (8%), while compensating extractions were performed in 51 cases (17%). Figure 2 shows the relationship between each FPM and the reasons for extraction.

Significant differences were found among the choice of anaesthetic used for extraction of FPMs in the three centres ( $p = 0.000$ ). In Manchester, general anaesthesia was the main mode for extraction (77 cases), while local anaesthesia alone and inhalation sedation with local anaesthesia were used in 12 and 11 cases respectively. In Liverpool and Sheffield, general anaesthesia was used in 55 and 47 cases respectively, however there was a noticeable difference in the use of local anaesthesia alone (43 cases in Liverpool and 22 cases in Sheffield) and

Table 3 The age of the children in months (SD) and the anaesthetic used for extraction of FPMs

Anaesthesia used (n)	GA (179)	LA(77)	IS & LA (44)
Mean age (SD)	123.8 (23.7)	150(25.3)	143.5 (23.2)

GA = general anaesthesia; LA = local anaesthesia; IS & LA = inhalation sedation with local anaesthesia

Table 4 Relationship between the number of FPMs extracted and the mode of anaesthesia used

Number of FPMs	Anaesthetic used			
	GA (%)	LA (%)	IS & LA (%)	Total (%)
1	22 (25%)	46(53%)	19 (22%)	87 (100%)
2	49 (58%)	28 (33%)	26	85 (100%)
3	9 (90%)	0 (0%)	1 (10%)	10 (100%)
4	99 (84%)	3 (2%)	16 (14%)	118 (100%)

Chi-square value = 89.339;  $p = 0.000$

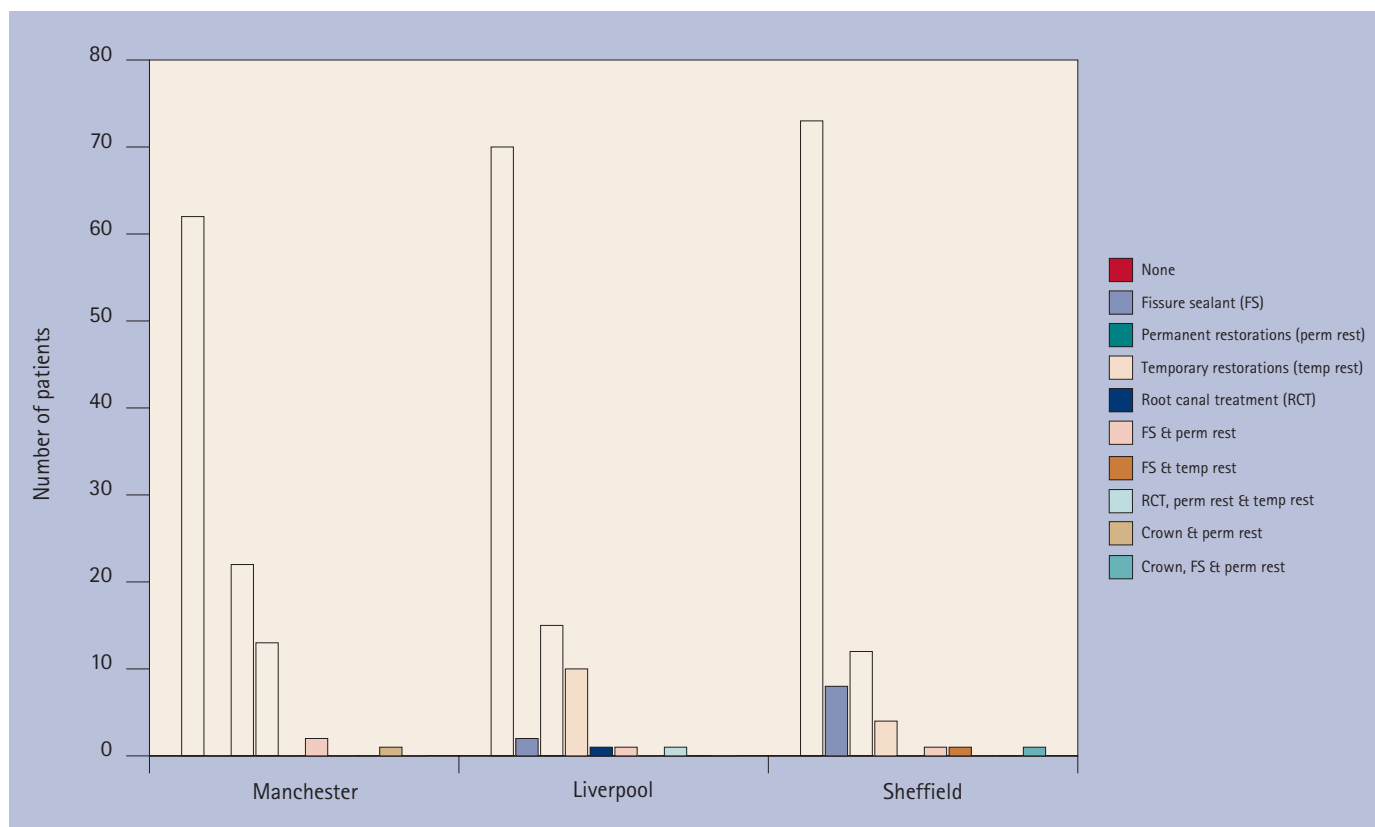


Fig. 3 Previous treatment of first permanent molars in the three centres

inhalation sedation with local anaesthesia (2 cases in Liverpool and 31 cases in Sheffield).

A statistically significant difference was found between the age of the children and the choice of anaesthetic ( $p = 0.000$ ,  $F\text{-ratio} = 37.091$ ) (Table 3). There was also a statistically significant difference between the number of teeth extracted and the choice of anaesthetic ( $p = 0.000$ ) (Table 4).

Orthodontic assessment was performed by an orthodontist or a consultant in paediatric dentistry in 31 and 35 of the cases in Manchester and Liverpool respectively. This compared to 95 cases in Sheffield, while 23, 12 and 5 cases in Manchester, Liverpool and Sheffield respectively had orthodontic assessments carried out by a consultant orthodontist. No relationship was found between seeking an orthodontic assessment and the number of teeth proposed for extraction ( $p = 0.06$ ).

Two hundred and nineteen (73%) of the cases had a class I incisal relationship compared to 61 (20%) with class II and 20 (7%) who had class III. One hundred and fifty-three (51%) had no premolar crowding, 121 (40%) had premolar crowding and in 26 (9%) it was difficult to predict the presence or absence of premolar crowding. No significant differences were found among the incisal relationship, premolar crowding and the number of FPMs proposed for extraction.

There were four cases with absent second premolars; nevertheless one of these cases had all four FPMs removed due to caries with poor prognosis.

Two hundred and five (68%) cases had not received previous treatment for the FPMs, 49 (16%) cases had permanent restorations and 27 (9%) had temporary restorations. Fissure sealants were detectable in ten (3%) cases. Six cases (2%) had a combination of restoration and fissure sealant. Two cases had root canal treatment and two had preformed crowns. A similar

distribution of previous treatment was found among the three centres (Fig. 3)

History of previous extraction was noted in 31, 45 and 44 children in Manchester, Liverpool and Sheffield respectively. The mean number of teeth extracted previously were 4.5 (SD 3.1), 3.6 (SD 2.6) and 6.8 (SD 4.2) in Manchester, Liverpool, and Sheffield respectively. Of the 120 children with a history of previous extractions, 84 (70%) underwent general anaesthesia, 31 (26%) local anaesthesia alone, and three (2%) underwent inhalation sedation with local anaesthesia. One child had previous extractions both under general anaesthesia and local anaesthesia. One parent could not recall the anaesthetic mode used for the extractions.

In this group of children who had previous extractions, the majority (83 [70%]) had had them in a hospital environment, 11 (9%) in the community dental service, 25 (21%) at their general dental practitioner, while one could not recall this information.

## DISCUSSION

In this study the mean age for extraction of the first permanent molars was 11 years old in the three centres, which is older than the widely recommended age for extraction (8–10 years old).<sup>11,12</sup> This suggests a possible delay in referral by general dental practitioners, which might be related to the lack of national guidelines on the treatment of FPMs. Interestingly, about half of the patients who attended the three centres were classified as regular attendees, however the majority of the patients had received no previous treatment on their FPMs.

A significant difference was found between the number of teeth extracted in Liverpool compared to Manchester and Sheffield. In Liverpool, only one quarter of children had all

four FPMs extracted compared to just under half of the children seen in Manchester and Sheffield.

Significant differences were found between the number of teeth extracted and the mean age. Those children who had four FPMs extracted were younger (mean age 10 years old) than those who had one or two FPMs extracted (mean age 12 years old). The differences in the number of teeth extracted could be explained by the controversy and lack of evidence with regard to treatment planning for extraction of FPMs.<sup>15</sup>

In this study, caries with poor prognosis was the main reason for extraction in 89% of the cases and MIH accounted for the remaining 11%. Balancing and compensating extraction were carried out in 8% and 17% of these cases respectively. The majority of compensating extractions were upper FPMs. This concurs with current expert opinion.<sup>11</sup>

Significant differences were found between the mode of anaesthesia used in the three centres, with Manchester using general anaesthesia for three quarters of their patients, followed by local anaesthesia alone and inhalation sedation with local anaesthesia in 12 and 11 cases respectively. On the other hand, Liverpool and Sheffield used general anaesthesia in 55 and 47 cases respectively, however there was a noticeable difference in the use of local anaesthesia (43 cases in Liverpool and 22 cases in Sheffield) and inhalation sedation with local anaesthesia (2 cases in Liverpool and 31 cases in Sheffield). These differences can be explained by the differences in the number of teeth extracted in the three centres, with Liverpool having more patients planned for removal of one or two FPMs.

The anaesthetic used was significantly linked to the age of the patients. The mean age of patients who had general anaesthesia was 10 years old, in comparison to 12 years for those who had local anaesthesia and inhalation sedation with local anaesthesia. In this study the children who had all four FPMs extracted were more likely to have a general anaesthetic than those who had one FPM extracted. This agrees with the results of previous studies, which showed that the number of teeth and the age of the child are among the most important factors affecting the choice of the anaesthetic.<sup>17</sup>

As expected, the majority of children in this study had class I occlusion. More than half of the children received an orthodontic assessment. However, no significant relationship was found between orthodontic assessment and the number of FPMs extracted. The decision to go ahead with extraction of FPMs without orthodontic assessment may be explained by a number of factors such as pain, unrestorable teeth, poor co-operation and patient and parental attitude towards future dental treatment.<sup>12</sup>

A total of 120 children had previously experienced extractions, and the majority of FPMs (68%) extracted had received no previous treatment: only 5% had evidence of fissure sealants. Although it is well established that the caries status in young permanent teeth is related to the status in the primary teeth,<sup>1,18</sup> the results of this study suggest that these children with a high caries risk were not targeted with a prevention

strategy including the use of fissure sealants, which have been shown to be effective in preventing dental caries in susceptible teeth and individuals.<sup>19,20</sup> The need to resort to general anaesthesia in more than half of the children may be due to a lack of co-operation, which may explain the low number of fissure sealants and restorations in the FPMs proposed for extraction.

In conclusion, the children who are attending dental hospitals for extraction of FPMs tend to be older than the optimal age for achieving space closure. Primary care dentists may benefit from a set of guidelines advising when to refer children for extraction of FPMs. This study also highlights the need for extensive prevention programmes targeted at those children with high caries risk.

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