

Mesial migration and loss of first molars among young adolescents in Kuwait

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Objective Our aim was to determine the prevalence of and factors associated with mesial migration and/or loss of first molars in 13-14-year-old school children in Kuwait. **Methods** A population-based sample of 1,583 eighth grade students of mean age 13.23±0.42 yrs, representing about 7% of the target population, were selected using multistage cluster sampling methods. Information on nationality, family income, and number of siblings was collected through subject and family interview. Any mesial migration or loss of first molars as well as visible caries was recorded in a well lit classroom. **Results** The prevalence of mesial migration and/or loss was 11.4%. Almost 70% of this occurred only in the mandible, and the majority (75.7%) had only one tooth affected ($p<0.01$). Although the prevalence differed with residential geographical regions ($p<0.01$), there were no gender differences ($p>0.05$). The prevalence also differed with family income ($p<0.05$), increased ($p<0.05$) with increasing number of siblings, and was higher ($p<0.001$) in subjects with presence of caries lesions (22.2%) than in those without (9.6%). **Conclusions** About 12% of current age cohorts of school children in Kuwait are likely to experience mesial migration and/or loss of one or more first molars. The conditions are associated with presence of untreated caries lesions. Private school attendance and high as well as low family income are associated with a decreased level of mesial migration and/or loss of one or more first molars. Increased number of siblings is a risk factor.

Key words: First molar loss, mesial molar migration, prevalence, risk factors.

Introduction

Premature loss of deciduous molars is observed more often in the mandible than in the maxilla, and is associated with perimeter loss due to migration of the adjacent teeth into the extraction sites (Kisling and Høffding, 1979; Northway *et al.*, 1984). The mesial migration of the first permanent molars is typically expressed as rotation in the maxilla and as tipping in the mandible, is more pronounced in the upper arch, is more pronounced following loss of the second deciduous molars, and is more pronounced the earlier the loss (Kisling and Høffding, 1979; Northway *et al.*, 1984). The distal migration of the deciduous canines is expressed as tipping, is more pronounced in the mandible, and is more pronounced following loss of the first deciduous molar (Kisling and Høffding, 1979; Northway *et al.*, 1984). While changes in maxillary incisor positions are minimal, the mandibular incisors may upright and migrate to the side of extraction (Pedersen *et al.*, 1978; Kisling and Høffding, 1979). The effects on the permanent dentition may be occlusal asymmetries, arch length deficiency in affected posterior segments with possible ectopic eruption or impaction of second premolar or canine, and increased overbite (Pedersen *et al.*, 1978; Northway *et al.*, 1984).

Childhood extraction of permanent first molars is also more frequent in the mandible (Thilander and Skagius, 1970). The tooth migration into the extraction sites follows a pattern similar to that seen after premature loss of the deciduous second molars, and is generally more favorable

in the maxilla than in the mandible (Thilander and Skagius, 1970). The distal migration of the premolars may sometimes be pronounced in the mandible, particularly following very early extraction, resulting in large inter-premolar spaces and occasional cases of distal impaction of the second premolar (Thilander and Skagius, 1970; Penchas *et al.*, 1994). Second molar migration expressed as tipping is also a larger problem in the mandible, particularly following late extraction (Thilander and Skagius, 1970). While supra-eruption of the maxillary first molars is a common observation following extraction of the antagonist, prohibiting favorable migration of the mandibular second molars, the mandibular first molars seldom supra-erupt (Thilander and Skagius, 1970; Penchas *et al.*, 1994). In addition, extraction in the mandible is associated with increased overjet and overbite due to incisor retroclination (Alhaija *et al.*, 2000). The occlusal sequelae of first molar extractions may therefore be occlusal asymmetries, supra-eruptions of opposing first molars, open extraction sites with tipped adjacent teeth, interdental spacing in the premolar and canine area of affected quadrants, and increased overjet and overbite.

Epidemiologic studies show improvements in dental health among western societies over the last decades (Haugejorden and Birkeland, 2005 and 2006; Psoter *et al.*, 2006; Pitts *et al.*, 2006 and 2007; Shulte *et al.*, 2006; Dye *et al.*, 2007) to the point that more than 60% of current 11-12-year-olds are without caries experience (Pitts *et al.*, 2006; Schulte *et al.*, 2006). However, sig-

nificant differences exist among various regions of each population (Haugejorden and Birkeland, 2005; Pitts *et al.*, 2006 and 2007; Schulte *et al.*, 2006), and sizable population groups demonstrate D_3MFT and d_3mft scores larger than 3. Since less than 50% of children and adolescents with dentin decay is likely to receive operative care (Pitts *et al.*, 2006 and 2007), tooth morbidity due to caries may therefore still represent a clinical problem. Epidemiologic information in this area is very limited. Some epidemiologic studies have detected an inverse relationship between socioeconomic status and dental caries (Psoter *et al.*, 2006; Haugejorden and Birkeland, 2006). Parameters of significance for mesial migration and early loss of first permanent molars may therefore also be established.

Since 1994 Kuwait has administered free preventive and curative dental care to all children between five and 15 years in the six governorates of the country. Despite these efforts, nationwide figures show that about 75% of current 12-14-year-olds have caries experience, with a restorative index as low as about 20% (Al-Mutawa *et al.*, 2006). In keeping with epidemiologic data from other countries, the variation among governorates is considerable. These figures, combined with limited treatment options available to preschool children, may imply an increased risk for morbidity of deciduous and first permanent molars among children and young adolescents. The purpose of this study was to determine the prevalence of mesial migration and loss of first permanent molars in 13- to 14-year-old school children in Kuwait, and to identify variables that are related to these conditions.

Methods

The subjects were selected from 13-14-year-old 8th grade students in Kuwait following approval by the Ethics Committee of Faculty of Dentistry, Kuwait University. A stratified cluster sampling method was utilized, defining the students in the government schools of each of the six administrative areas as six different strata, and the students of private schools as the 7th stratum. The number of students to be examined from each stratum was estimated according to proportions, following random sampling procedures when selecting the schools (clusters) from each stratum and the students from each school. A total of 1583 students, (788 boys and 795 girls) were examined, representing about 7% of the target population.

Information on nationality and number of siblings was recorded prior to the clinical examinations. Orthodontic treatment experience was recorded as present in 66 subjects due to evidence of active treatment in progress or confirmed completion, either with fixed or removable appliances. Information on total family income was collected through phone interview with the parents, and recorded as $KD < 500$, $500 < KD < 1000$, $1000 < KD < 2000$, and $KD > 2000$.

The Research Department of the Kuwaiti Ministry of Education had authorized student examinations during school hours, and the respective principals provided a well lit room for the purpose. All preparations were made by a well trained recently graduated dentist. Each of four calibrated orthodontists examined 25 students one day per week for 16 weeks, using gloves, mirrors

and spatulas. Mesial tipping and/or rotation of maxillary and mandibular first molars concomitant with reduced space mesial to the first molar in question was scored as mesial migration. Missing first molars and presence of permanent teeth with visible active caries were also recorded. Of the 66 subjects with orthodontic treatment experience, 56 allowed valid scoring of mesial migration and/or loss of first molars on initial study models. Hence, valid scores were obtained from 787 boys and 786 girls of mean age 13.23 ± 0.42 yrs.

Following initial calibration, 40 subjects were examined twice about two weeks apart by all four examiners. The mean intra class correlation coefficients for mesial migration and loss of first molars as well as for presence of visible caries ranged from 0.75 to complete agreement between the first and second scores of all examiners and from 0.92 to complete agreement among the four examiners.

Number of siblings was categorized as ≤ 4 , as ≥ 5 but ≤ 8 , and as ≥ 9 . Prevalence of mesial migration and/or missing first molars by subject, tooth, dental arch, gender, nationality, area, family income, sibling category, and presence of visible caries were computed. Chi square tests were used to evaluate the differences. Finally, stepwise multiple logistic regressions were employed to identify the independent predictors for mesial migration and/or loss. Variables were successively entered into the models if their effects were significant at $p < 0.05$. At each step the variable with the lowest p-value was included. Previously entered variables were excluded if their effects were no longer significant ($p > 0.05$) upon inclusion of a new variable. The final models were determined when no remaining variables had a significant effect ($p > 0.05$).

Results

Mesial migration of first molars was not found in either the mandible or the maxilla of 1,465 subjects i.e. 93.1% of the 1,573 subjects that could be scored (Table 1). A total of 108 subjects (6.9%) presented with one or more mesially migrated first molars. Of those, 75 (60+15) (69.4%) demonstrated mesial migration only in the mandible, 28 (22+6) (25.9%) only in the maxilla, and 5 (3+0+1+1) (4.6%) in both arches ($p < 0.001$) (Table 1). Only 26 subjects had experienced more than one mesially migrated molar (Table 1). The prevalence was the same in boys and girls (6.9%), and no differences were detected between Kuwaiti ($n=1479$) and non-Kuwaiti ($n=94$)

Table 1. Cross-tabulation of number of subjects with mesial migration of no (0), one (1) and two (2) first molars in the maxilla and the mandible in a population based sample of 13-14-year-old school children in Kuwait (10 subjects with missing score)

		Mandible			
		0	1	2	Total
Maxilla	0	1465	60	15	1540
	1	22	3	1	26
	2	6	0	1	7
	Total	1493	63	17	1573

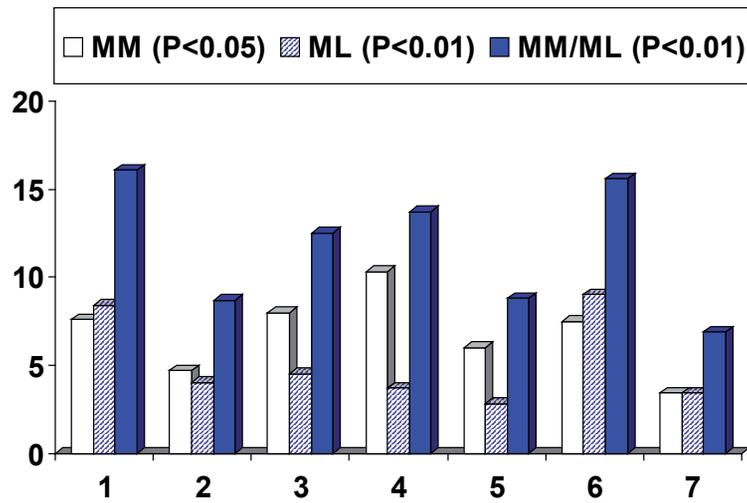


Figure 1. Graph demonstrating prevalence of mesial migration (MM), loss (ML) and MM and/or ML (MM/ML) of first molars by area (1: Capital, 2: Hawalli, 3: Mubarak Al-Kabeer, 4: Al-Ahmadi, 5: Al-Farwaniya, 6: Al-Jahrah, 7: Private Schools)

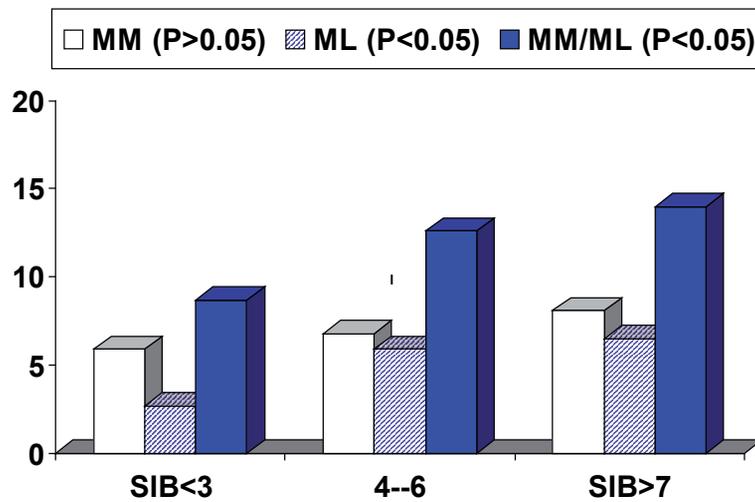


Figure 2. Graph demonstrating prevalence of mesial migration (MM), loss (ML) and MM and/or ML (MM/ML) of first molars by number of siblings

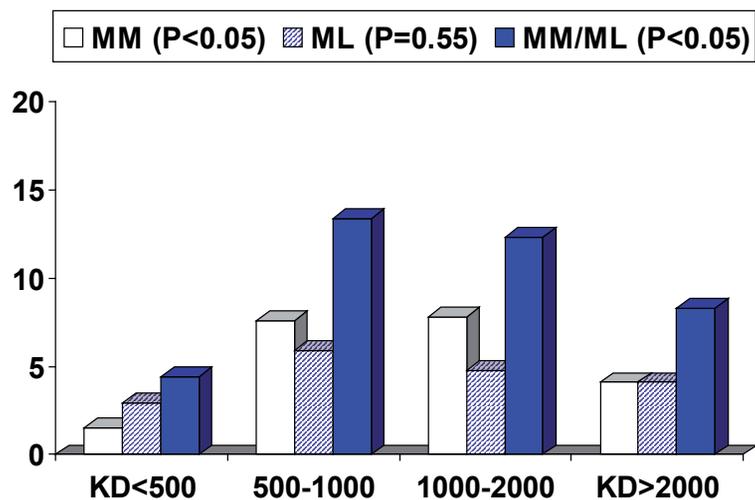


Figure 3. Graph demonstrating prevalence of mesial migration (MM), loss (ML) and MM and/or ML (MM/ML) of first molars by family income

school children (7.1% & 3.2%, respectively, $p>0.05$). However, the prevalence differed among the subjects in the different administrative areas ($p<0.05$), with lowest prevalence among subjects from government schools in Hawalli and among subjects from private schools (Fig. 1). The prevalence was similar ($p>0.05$) in subjects with presence (8.6% of 266) and absence (8.5% of 1307) of caries lesions as well as among subjects with different sibling categories ($p>0.05$, Fig. 2). However, the effect of family income approached significance ($p=0.06$), with a tendency for lower prevalence in subjects with parents in the highest and lowest income categories (Fig. 3).

First molar loss was observed in 80 (5.1%) of the 1,573 subjects that could be examined, of whom 57 (71.3%) had loss only of mandibular molars, 18 (22.5%) only of maxillary molars, and five (6.3%) of molars in both arches ($p<0.01$). A total of 17 subjects had more than one missing first molar (Table 2). The prevalence was higher ($p<0.05$) in females (6.2%) than in males (3.9%), but no difference was detected between Kuwaitis and non-Kuwaitis (5.3% and 2.1%, respectively, $p>0.05$). The frequency was different among the subjects in the different administrative areas ($p<0.01$), and appeared higher among subjects attending government schools in the Capital and Jahra areas (Fig. 1). Although the prevalence increased ($p<0.05$) with increasing number of siblings (Fig. 2), and was higher ($p<0.001$) in subjects with presence of caries lesions (13.9%) than in those without (3.3%), no differences ($p>0.05$) were detected among subjects from families of different income (Fig. 3).

Only three subjects had presence of both mesial migration and loss of first molars. The majority of the 185 subjects with mesial migration and/or loss had only one

Table 2. Cross-tabulation of number of subjects with loss of no (0), one (1) and two (2) first molars in the maxilla and the mandible in a population based sample of 13-14-year-old school children in Kuwait (10 subjects with missing score)

		Mandible			Total
		0	1	2	
Maxilla	0	1493	47	10	1550
	1	16	2	0	18
	2	2	2	1	5
	Total	1511	51	11	1573

Table 3. Cross-tabulation of number of subjects with mesial migration and/or loss of no (0), one (1) and two (2) first molars in the maxilla and the mandible in a population based sample of 13-14-year-old school children in Kuwait (10 subjects with missing score)

		Mandible			Total
		0	1	2	
Maxilla	0	1388	103	26	1517
	1	37	6	1	44
	2	7	3	2	12
	Total	1432	112	29	1573

affected tooth (Table 3), and 129 (69.7%) of these subjects had mesial migration and/or loss only in the mandible, 44 (23.8%) only in the maxilla, and 12 (6.5%) in both arches ($p<0.01$). The prevalence was similar ($p>0.05$) in boys (10.5%) and girls (12.9%), but higher ($p<0.05$) in Kuwaitis (12.2%) than in non-Kuwaitis (5.3%). The prevalence differed among the subjects in the different areas ($p<0.01$), and appeared lowest among subjects attending private schools as well among subjects attending government schools in Hawalli and Farwaniya (Fig. 1). The prevalence increased ($p<0.05$) with increasing number of siblings (Fig. 2), and was higher ($p<0.001$) in subjects with presence of caries lesions (22.2%) than in those without (9.6%). The prevalence also differed among subjects from families of different income ($p<0.05$), and appeared lower in subjects from the lowest and highest income groups (Fig. 3). Logistic regression demonstrated that mesial migration and/or loss of first molars could be predicted according to area, with the odds being 2.6 times higher for subjects attending public schools in the Capital ($p<0.01$), 2.5 times higher for subjects attending public schools in Jahra ($p<0.01$), and 2.2 times higher for subjects attending public schools in Ahmadi ($p<0.05$). Nationality, number of siblings, or family income was not included in the prediction model. When presence of caries was offered in the model, that was the only parameter associated with mesial migration and/or loss (OR=2.68, $p<0.001$).

Discussion

Initial perimeter reduction is reversible in a high proportion of children with premature loss of deciduous molars (Northway *et al.*, 1984). The effect on premolar and canine alignment may also be limited in subjects with good intercuspation and presence of interdental spaces prior to extraction (Northway *et al.*, 1984). Finally, optimal space maintenance procedures may prevent tooth migration into the extraction sites. However, assuming random effects of these mechanisms, our findings may indirectly support that deciduous molar extractions are more prevalent in the mandible than in the maxilla (Kisling and Høffding, 1979; Northway *et al.*, 1984). We could also confirm that loss of first permanent molars is about twice as common in the mandible (Thilander and Skagius, 1970). Recent findings suggest that more than 85% of 5-6-year-old children in Kuwait have caries experience in the deciduous teeth (Al-Mutawa *et al.*, 2006). Our finding that more than 10% of young adolescents in Kuwait have experienced mesial migration and/or loss of one or more first molars may therefore not be unexpected. The figure may be a reason for concern, and support recent epidemiologic conclusions that a clinically significant portion of children from societies administering free dental care still suffer from the burden of preventable dental diseases (Pitts *et al.*, 2006 and 2007).

The occlusal consequences of mesial molar migration in subjects with otherwise almost ideal occlusion may be relatively small. Affected quadrants in the maxilla may develop tendencies for Class II relationships with the opposing molars, and continued migration following compensatory extraction of first or second premolars may be associated with acceptable occlusal results and main-

tenance of bilateral Class I canine relationships. Premolar extraction may be equally successful in the mandible provided the tendency for distal migration of the canines has not produced unacceptable incisor occlusion and canine asymmetry. However, a recent study of Kuwaiti adolescents (Behbehani *et al.*, 2005) has confirmed that only about 30% of adolescent populations have natural development of almost ideal occlusion. Tooth migration in the remaining 70% with moderate to severe malocclusion is likely to complicate any otherwise necessary orthodontic treatment procedures. Mesial molar migration may be particularly detrimental in the maxilla of subjects with Class II malocclusion. Although mesial migration of the mandibular molars may improve a pre-existing Class II molar relationship, any distal migration from the anterior will worsen the Class II canine relationship and the overbite. Detailed accounts of effects of molar and canine migration on treatment need in different types of malocclusion are lacking. However, findings by Pedersen *et al.* (1978) suggest that maintenance of tooth positions through improved primary dental care may be considered good economy.

Due to the generally favorable migration pattern (Thilander and Skagius, 1970; Penchas *et al.*, 1994), maxillary first molar extraction in the mixed dentition may have minor occlusal consequences in cases with almost ideal occlusion at time of extraction. However, the likelihood of complete space closure through migration from the posterior may be detrimental in subjects with Class II malocclusions. The resulting Class II relationship of the maxillary second molars with the mandibular first molars may severely complicate future orthodontic treatment. If premolar extraction turns out to be necessary for overjet correction, the dentition may be severely dilapidated in cases with congenital absence of the third molars. Class II malocclusion is also a contraindication for early extraction of mandibular first molars, particularly in cases with deep overbite. Any orthodontic advancement of the mandibular anterior segment that may be necessary to establish acceptable incisor and canine occlusion is likely to prohibit extraction site closure, thereby introducing a need for prosthetic replacement.

The high proportion of mandibular first molar extraction without compensatory extraction of the antagonistic first molar in the maxilla (Table 2) may be a reason for concern. Such extraction should not be performed in cases with Class II molar relationship, since the occlusal contact between the maxillary first molar and the deciduous second molar in the mandible will prevent supra-eruption, and since maxillary first molar extraction in Class II cases is likely to reduce the potential for successful results of future orthodontic treatment. However, supra-eruption of the maxillary first molars in Class I cases may prevent optimal migration of the mandibular second molar (Thilander and Skagius, 1970; Penchas *et al.*, 1994), thereby introducing a need for orthodontic treatment that would otherwise have been unnecessary.

The observed differences in mesial migration among the governorates may reflect regional inconsistencies in prophylaxis and recall routines as well as in space maintenance and other treatment procedures. Similar explanations may be offered for the variation in prevalence of first molar loss, and support recent findings regard-

ing variations in dental health and restorative treatment index among children in the various governorates of Kuwait (Al-Mutawa *et al.*, 2006). Differences in outcome parameters and timing of the observations make direct comparisons between the two studies difficult. However, the general trends of district variations in dental health parameters support epidemiologic findings from other countries (Haugejorden and Birkeland, 2005; Pitts *et al.*, 2006 and 2007; Schulte *et al.*, 2006).

Although caries is the etiologic factor for premature loss of deciduous molars, which again is the cause of tooth migration, we could not establish any association between presence of unfilled caries and mesial molar migration. One reason may be that a sizable proportion of the subjects with early loss of deciduous molars had no visible signs of mesial molar migration at time of examination due to space regain during premolar eruption (Northway *et al.*, 1984) or successful space maintenance. Another may be differences in caries status in the early permanent dentition versus in the deciduous and early mixed dentitions. However, our findings that private school attendance was associated with reduced levels of mesial migration and loss of first permanent molars and that family income approached significance may support previous findings of associations between socioeconomic status and dental health (Psoter *et al.*, 2006; Haugejorden and Birkeland, 2006).

We detected an association between increased number of siblings and loss of first molars, suggesting effects of socio-economic parameters, and could confirm the very likely association between untreated caries in remaining permanent teeth and first molar loss. Our finding that the combination of loss and mesial migration of the first molars could be predicted according to area supports previous findings of regional differences in dental health (Haugejorden and Birkeland, 2005; Pitts *et al.*, 2006 and 2007; Schulte *et al.*, 2006). Our finding also that low family income was associated with reduced levels of mesial migration and loss of first permanent molars may support previous findings of an inverse relationship between socioeconomic status and dental caries (Psoter *et al.*, 2006; Haugejorden and Birkeland, 2006). The fact that presence of untreated caries was the only associated parameter if included in the modeling procedures suggests an interaction between untreated caries and the remaining parameters, with untreated caries being most important for the conditions under study.

Conclusions

About 12% of current age cohorts of school children in Kuwait are likely to experience mesial migration and/or loss of one or more first molars in the early permanent dentition, and more than 20% of such subjects are likely to have visible caries lesions as opposed to less than 10% of those without mesial migration and/or loss ($p < 0.001$). Private school attendance and high as well as low family income are associated with a decreased level of mesial migration and/or loss of one or more first molars. Increased number of siblings is a risk factor.

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