Impaction of Permanent Mandibular Second Molars in Ethnic Chinese Schoolchildren

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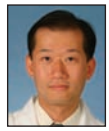

ABSTRACT

Objective: To investigate the prevalence of impaction of permanent mandibular second molars and associated dental and radiographic characteristics of Chinese children in Hong Kong.

Materials and Methods: Dental and radiographic records of a group of Chinese schoolchildren were studied retrospectively. Cases of impaction of 1 or both permanent mandibular second molars were selected. Demographic data and dental and radiographic findings were recorded and analyzed. The angle of the impacted second molars was measured on panoramic radiographs.

Results: Among the 3,053 records reviewed, 32 cases of impaction of permanent mandibular second molars were identified and studied. Mesial impaction was found in all but 1 case. The angle of the mesially impacted teeth ranged from 13° to 75°. Mandibular crowding and the presence of third molars were common. Dens evaginatus, taurodontism and Class III malocclusions were significantly more prevalent in the study group than in the general population of Chinese children of similar age.

Conclusions: The prevalence of impaction of permanent mandibular second molars in Chinese children was estimated to be 1%. Thorough and regular examination of the child's developing dentition is recommended to diagnose dental impaction promptly.

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Dental impaction is defined as cessation of eruption of a tooth caused by a physical barrier in the eruption path or the abnormal position of the tooth.[1] In the permanent dentition, third molars are the most commonly affected, accounting for over 80% of all impacted teeth.[2,3] After third molars, maxillary canines are the most frequently impacted teeth, followed by second premolars.[2,3]

Impaction of permanent second molars is relatively rare. It is often expressed as the percentage of all retained teeth in a group of patients, and prevalence has only been reported in a few studies. In a radiographic study of 5,000 American army recruits, it was 0.06%.[3] The prevalence seemed to be higher when patients of younger age were included. Varpio and Wellfelt[4] found 88 such cases among 10 to 19 year olds in the public dental service in Sweden between 1960 and 1974, and estimated the prevalence to be 0.15%. A higher prevalence of 0.3% was found by Johnsen,[5] who examined radiographs of 1,032 young people, aged 8–18, in the United States. In a radiographic study of 1,041 12-year-old Hong Kong Chinese children in 1988, the prevalence

Figure 1: Panoramic radiograph of a boy with bilaterally impacted permanent mandibular second molars. Taurodontism was seen in both maxillary second molars.

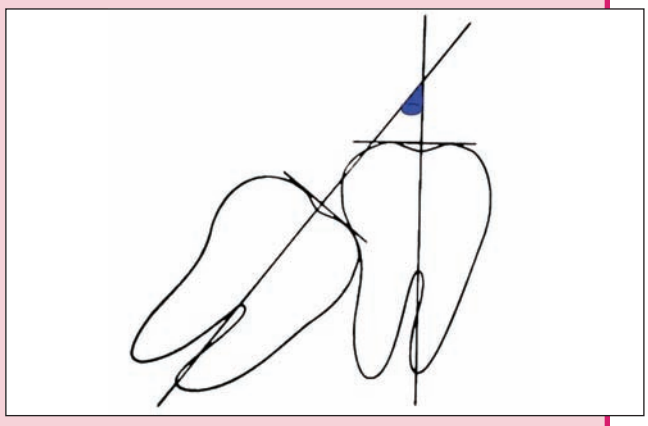

Figure 2: Diagram showing measurement of the angle of inclination between the permanent mandibular first and second molars.

of impaction of permanent mandibular second molars was 0.58%.[6]

Evans[7] noted an increasing trend in impaction of permanent mandibular second molars in a dental hospital in the United Kingdom. Recently, Cho and others[8] also noted a relatively high prevalence of this condition during a review of radiographs of a group of Chinese children in Hong Kong. However, the number of cases in these latter 2 studies was small (9 and 7, respectively).

The aim of the current study was to investigate the prevalence of impaction of permanent mandibular second molars and associated dental and radiographic findings in a larger sample of Chinese children. Although our study population was Chinese, the findings will be useful to Canadian dentists whose patients include an increasing number of people from Asia. In fact, people of Chinese ethnicity have been described as "the largest visible minority in Canada."[9]

Materials and Methods

The study was carried out retrospectively in a school dental clinic serving over 35,000 primary schoolchildren in Hong Kong. The clinical records and radiographs of grade 6 (the highest grade in primary school) children who attended the clinic in 2005 were reviewed. Records were selected for study if they met the following criteria:

- the children were ethnic Chinese
- no systemic syndromes were involved
- 1 or both permanent mandibular second molars were impacted (a molar would be recorded as impacted if its complete eruption to occlusal height was prevented by abnormal contact with another tooth in the same arch and root development of the impacted tooth was at least 75% complete)[7] (**Fig. 1**)
- good-quality panoramic radiographs were taken at the time of diagnosis and at least 1 year afterward.

All panoramic radiographs were taken with CP-G Plus film (Agfa, Mortsel, Belgium) in an Orthopantomograph OP100 machine (Instrumentarium, Tuusula, Finland). The films were processed in an automatic processor (Dent-X Excel, Elmsford, N.Y.) using Dürr-Automat XR solutions (Dürr Dental, Bietigheim-Bissingen, Germany).

The selected dental records and radiographs were examined by the first author. Demographic data and dental findings for these patients were recorded. All selected radiographs and records were reviewed by the same person 1 month after the original analysis and the results of the 2 examinations were compared for discrepancies. Data were pooled and analyzed for distribution by sex and side of jaw, as well as for associated dental anomalies and malocclusion. Differences were analyzed statistically using tests for categorical data (binomial, Fisher's exact or McNemar's test) if needed. Differences were considered statistically significant at the $p < 0.05$ level. Angle of inclination of the impacted second molars was measured by tracing the radiographs on overlying matte acetate paper as described by Evans.[7] A line, which was perpendicular to the tangent to the tips of the cusps, was drawn through the middle of the crown and root of the impacted second molar and another was drawn on the adjacent permanent first molar (**Fig. 2**). The angle between these lines was measured twice, and the mean of the 2 measurements was taken as the angle of impaction.

Results

The dental records of the 3,053 grade 6 children who attended the clinic in 2005 were reviewed. Impaction of 1 or both permanent mandibular second molars was

found in 34 children at the consultations. Of these, 2 were excluded as the impacted molars self-corrected after 12 months. No cases had to be excluded due to poor quality radiographs or syndrome involvement. The resulting prevalence was 1%. The age of the affected children ranged from 11 to 14 years, with a mean of 12.0 ± 0.6 years. The male-to-female ratio was 1:1.7, which was not significantly different from the expected 1:1 ratio (binomial test $p > 0.05$). In 22 cases, impaction was unilateral: 16 on the left and 6 on the right. This difference was close to but not quite significant with the p value at 0.055 (McNemar's test). In the remaining 10 cases, impaction was bilateral. While more girls than boys were affected unilaterally, the reverse was seen in bilateral cases. However, the number of cases was too small for further analysis.

Complete concordance was found between the 2 evaluations, which were 1 month apart. The associated dental and radiographic findings are summarized in **Table 1**. As study models were not routinely made, only the presence or absence of crowding was noted in the dental records. Mandibular crowding was observed in 20 cases (63%). Class III molar and incisor malocclusions were seen in 18 and 13 cases, respectively (**Table 2**). Mandibular third molars were developing in all but 1 case. Premolars with dens evaginatus were seen in 6 cases (19%), and 41 of the permanent maxillary second molars (64%) were found to be taurodontic. Only 1 impacted tooth had a negative inclination; all others were mesially impacted. The angle of the mesially impacted teeth ranged from 13° to 75°. In no case had the permanent first molar been extracted. Neither proximal caries nor fillings were seen in permanent first molars.

Discussion

The prevalence of impacted permanent mandibular second molars in this study population was 1%. This may be an underestimate, as panoramic radiographs are not routinely taken in the School Dental Care Service and some deep impaction may have gone unnoticed during clinical examination. Despite this, the figure was higher than found in white Caucasian populations (0.06%–0.3%).[3–5] Larger tooth size among Chinese people compared with Caucasian people may partly explain the higher prevalence.[13] The prevalence in this study was also higher than that found in Hong Kong Chinese 12-year-old children in 1988 (0.58%).[6] Our higher figure is similar to that found by Evans[7] at an orthodontic clinic in the United Kingdom.

Evans suggested that the decreasing rate of extraction of permanent first molars could be responsible for the increasing trend toward impaction of permanent mandibular second molars. This could also be true of our study population. In the 1988 study,[6] the rate of permanent first molar extraction in Hong Kong Chinese children was 5.8%. In our study, only 11 out of 3,053 children (0.36%) had had 1 or both permanent mandibular first molars extracted. This decreased rate of extraction was also found by Ma and others[9] among Hong Kong Chinese adults.

All patients in our study have been followed up clinically and radiographically for no less than 12 months. Thus, the possibility of misdiagnosing a partially erupting tooth as impacted at the initial examination can be ruled out.

In this study, more girls than boys presented with impacted permanent mandibular second molars and left side impaction was more common than right; however, these differences were not statistically significant. This differs from a previous study in Sweden which found significantly more boys than girls were affected and over half the cases were unilateral impaction on the right side.[4] The relatively small number of cases in this study and the different age and ethnic groups of children examined in these 2 studies make direct comparison difficult.

Previous studies have found that a third molar adjacent to an impacted second molar is seldom missing.[4,7,14] Our study confirmed this finding. Mandibular third molars were seen developing in the panoramic radiographs in all but 1 case. In our study, only 1 impacted second molar showed a distal inclination; the rest were mesially impacted. This also agrees with findings from studies in Caucasian populations.[4,7] One of the reasons for this skewed distribution may be that during early development all mandibular molars are mesially inclined.[1,15]

Crowding has been cited as the most common cause of permanent mandibular second molar impaction.[4,7] In this study, mandibular crowding was noted in 63% of cases, concurring with previous studies. On the other hand, excess space in the molar region may also lead to impaction of permanent mandibular second molars. It has been suggested that close guidance of the distal root of the mandibular permanent first molar is needed for proper eruption of the adjacent second molar, a situation analogous to the eruption of the maxillary canines.[16] Nonetheless, excessive spacing was not observed in any of the patients in this study.

Vedtofte and others[14] reviewed the lateral cephalograms of 29 teenagers with arrested eruption of permanent mandibular second molars and found that these patients had an increased sagittal jaw relationship (Class II) compared with the general population in Denmark. As cephalometric radiographs were not used in our study, no direct comparison can be made. However, in our study, Class III molar and incisor malocclusions were common in Chinese children with impacted permanent mandibular second molars. It has been shown that Class III malocclusion is much more common in Chinese than in Caucasian populations.[10,12,17] Even so, compared with the general Chinese population,[12] the proportion of children with a Class I incisor or molar occlusion in our

Table 1 Demographic data and dental characteristics of the 32 children with impacted permanent mandibular second molars

Case	Age, years	Sex	Impacted tooth	Molar occlusion, Class[a]	Incisor occlusion, Class[a]	Upper crowding	Lower crowding	Tooth 37, angle (°)	Tooth 47, angle (°)	Notes[b]
1	11	F	37	III	III	Yes	Yes	52		17, 27 taurodontism
2	11	M	37	III	II	Yes	Yes	74		17, 27 taurodontism
3	12	M	37	II	II	Yes	No	58		
4	12	F	37	III	III	Yes	Yes	38		17, 27 taurodontism, 17 DE
5	12	F	37	I	I	No	No	27		17, 27 taurodontism
6	12	M	37	I	I	No	Yes	30		17, 27 taurodontism
7	12	M	37	I	I	Yes	Yes	59		
8	12	F	37	I	I	No	No	18		No sign of third molars
9	12	F	37	I	II	No	Yes	–8		35, 45 DE
10	12	F	37	III	II	Yes	Yes	27		17, 27 taurodontism
11	12	F	37	III	III	Yes	Yes	50		17, 27 taurodontism
12	12	F	37	III	III	Yes	Yes	59		
13	12	F	37	III	II	No	Yes	32		17, 27 taurodontism
14	12	F	37	I	I	Yes	Yes	45		15, 25, 35, 45 DE, supplemental 35
15	13	F	37	III	I	Yes	No	46		45 hypoplastic
16	14	M	37	I	I	No	No	27		35, 45 DE
17	12	F	47	III	III	No	No		13	17, 27 taurodontism
18	12	F	47	III	III	No	No		19	17, 27 taurodontism, 35 missing
19	12	F	47	III	III	No	Yes		38	17, 27 taurodontism, 44 DE
20	12	F	47	III	III	No	No		19	
21	12	M	47	III	II	Yes	Yes		46	17, 27 taurodontism
22	12	F	47	III	III	No	No		44	
23	11	F	37, 47	III	III	No	Yes	45	37	17, 27 taurodontism
24	11	M	37, 47	I	I	No	No	27	42	17, 27 taurodontism, 27, 34, 44 DE
25	12	F	37, 47	III	III	Yes	Yes	18	47	17, 27 taurodontism
26	12	M	37, 47	II	II	Yes	Yes	48	63	17, 27 taurodontism, 34, 35, 44, 45 DE
27	12	F	37, 47	I	I	No	No	35	33	17 taurodontism, mesiodens (extracted)
28	12	M	37, 47	III	III	Yes	Yes	33	46	17, 27 taurodontism
29	12	M	37, 47	III	III	Yes	Yes	28	28	17, 27 taurodontism, 22 DI
30	12	M	37, 47	I	I	Yes	Yes	61	57	17, 27 taurodontism
31	12	F	37, 47	II	II	No	No	30	52	17, 27 taurodontism
32	13	M	37, 47	I	I	Yes	Yes	75	56	

Note: DE = dens evaginatus; DI = dens invaginatus.
[a]*Molar and incisor occlusions were classified using Angle's and British Standard classifications, respectively.*[10]
[b]*Taurodontism was diagnosed using the criteria of Shifman and Chanannel.*[11]

Table 2 The distribution of molar and incisal occlusions in this study compared with a previous study of Chinese children of similar age in the general population

Occlusion	Class	No. cases in present study (%)	No. cases in the general population of 12–14 year olds (%)[12]	Statistical significance (Fisher's exact test)
Molar occlusion	I	11 (34)	691 (66)	$p < 0.001$
	II	3 (10)	225 (21)	Not significant
	III	18 (56)	134 (13)	$p < 0.001$
Incisor occlusion	I	11 (34)	716 (68)	$p < 0.005$
	II	8 (25)	202 (19)	Not significant
	III	13 (41)	132 (13)	$p < 0.001$
Total sample		**32**	**1,050**	

study was much lower among those with an impacted permanent mandibular second molar and the proportion of children with a Class III incisor or molar occlusion was much higher (**Table 2**). These differences were statistically significant (Fisher's exact test).

Vedtofte and others[14] found a high prevalence of dens invagination and taurodontic maxillary second molars in patients with arrested eruption of permanent mandibular second molars. They suggested that there was an association between morphological deviations and periodontal membrane malfunction, the latter causing eruption disturbances. In our study, dens invagination was seen in only 1 child with an impacted permanent mandibular second molar. In contrast, 6 of the 32 children had premolars with dens evaginatus (19%). This proportion is significantly higher than the 6.3%[8] found generally in Chinese children (Fisher's exact test, $p < 0.05$). Taurodontism is common in Chinese patients, affecting 41% of maxillary second molars.[11] Using the same diagnostic criteria, we found taurodontism in 41 of the 64 maxillary second molars (64%) in this study. This prevalence is significantly higher than that seen in the general Chinese population (Fisher's exact test, $p < 0.001$). It is possible that genetic factors controlling dental morphogenesis may also influence tooth size.[18,19] Deviations in tooth size could, in turn, lead to dental crowding as well as impaction.

In our study group, the angle of mesially impacted teeth ranged from 13° to 75°, similar to the 15°–65° range found in the United Kingdom.[7] Two impacted permanent mandibular second molars self-corrected 12 months after the initial diagnosis. Their initial angles were 15° and 35°. With the small number of cases, it was impossible to determine a critical impaction angle beyond which self-correction could not occur. The fact that some non-crowded, mild cases of impaction with angles < 20° (e.g., case 8) did not self-correct implies that other factors might be involved. Further studies with a larger sample are needed to explore this question.

Kavadia and others[20] emphasize the importance of close monitoring for impaction of permanent mandibular second molars. They suggest that active treatment should only be considered after an observation period of at least 12 months to rule out the possibility of self-correction. Our observations support their recommendation.

Once the chance of self-correction has been ruled out, dentists should discuss with patients and parents the various treatment options for the impacted molars, which may include:[16,21,22]

- orthodontic uprighting — this produces excellent results, but involves a long treatment period and may be contraindicated for molars with gross displacement or widely diverging roots
- surgical repositioning — this treatment produces quick results, but there is a risk of pulp necrosis, root resorption and ankylosis
- extraction of the impacted second molar to allow the third molar to drift mesially — success of this treatment depends on the eruption path of the third molar which could be unpredictable
- extraction of the impacted second molar and transplant of the third molar into the extraction site — this is technically demanding and carries a risk of pulp necrosis, root resorption and ankylosis.

Dentists must consider each patient's medical and dental condition, oral hygiene, motivation and expectations.[23] Referral to an orthodontist or oral surgeon is often needed.

Conclusions

The prevalence of impaction of permanent mandibular second molars in Chinese children in Hong Kong was found to be higher than previously reported. Although this relatively low prevalence (1%) cannot justify routine radiographic screenings for mandibular second molar impaction in adolescents, the importance of thorough and regular examination cannot be overemphasized. As

eruption time may vary, children with mixed dentition should be examined at 6-month intervals to monitor their eruption pattern and dental development.[24,25] The primary second molars and maxillary primary canines are replaced by their successors at dental age 12 and, typically, eruption of the permanent second molars occurs a few months later.[26] A 6-month delay in eruption of a permanent mandibular second molar compared with its contralateral counterpart or a 1-year delay in eruption of both molars should indicate a need for further radiographic investigation.[26] This is especially important if the child presents with mandibular crowding and, in the case of Chinese children, a Class III malocclusion.

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