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Concomitant developmental dental anomalies in Chinese children with dens evaginatus

S. Y. CHO, Y. KI, V. CHU & J. CHAN
School Dental Care Service, Department of Health, Hong Kong

Summary. *Aim.* To determine the prevalence of concomitant developmental dental anomalies in a group of Chinese children with dens evaginatus.
Methods. The dental records and orthopantomograms of 10–15 year old children and adolescents who had been diagnosed with dens evaginatus in a school dental clinic were reviewed retrospectively.
Results. Four hundred and forty-eight of 7102 (6·3%) children were found to have dens evaginatus. Concomitant developmental dental anomalies were found in 77 children (17·2%). The most commonly seen dental anomalies in the study population were hypodontia, hyperdontia, microdontic maxillary lateral incisor, and dental impaction. The prevalence of these anomalies did not differ significantly to that found in the general Chinese population. When analysed separately, however, the prevalence of supernumerary premolars was found to be higher in children with dens evaginatus than in the general population, and the difference was statistically significant ($P < 0{\cdot}01$).
Conclusion. Supernumerary premolars appeared to be more prevalent in Chinese children with dens evaginatus than in the general population. There may be an association of supernumerary premolars with dens evaginatus in this study population.

Introduction

Dens evaginatus is a developmental anomaly that can be defined as a tubercle from the surface of an affected tooth and is found most frequently in premolars [1,2]. The occurrence of dens evaginatus shows great racial difference, with higher prevalence in people of Mongoloid origin but rarer in Caucasian race. The prevalence of dens evaginatus has been reported to be 3% in Keewatin Eskimos [3] and ranged between 3% and 4·8% in Chinese [4–6].

Concomitant dental anomalies have been described in case reports of children with dens evaginatus [7], but only a few studies have reported the prevalence of concurrent developmental anomalies found in these patients. Yip identified 24 cases of dens evaginatus out of 1084 children, and among the 24 cases, two had dens invaginatus, one with a supernumerary mandibular premolar, and one with dens invaginatus and a mesiodens concomitantly [4]. Oehlers studied 110 patients with dens evaginatus and found one case of dens invaginatus, one with dental fusion of a mandibular incisor and canine, and another one with an odontome [8]. Goto *et al*. found 53 cases of dens evaginatus in a Japanese population, and two of those affected had dens invaginatus [1]. The small sample sizes in these early studies made the determination of a true association difficult. This study, which used a larger sample, aimed to investigate retrospectively the prevalence of concomitant dental anomalies in Chinese children with dens evaginatus.

Methods

This study was carried out in a school dental clinic that looked after more than 39, 000 Hong Kong primary school children. Orthopantomograms were routinely taken for children who were presented with dens evaginatus clinically, in order to screen for pathosis associated with anomalous teeth. It was the authors' clinical impression that a proportion of the children was also affected by other developmental

Correspondence: Dr Shiu-yin Cho, Fanling School Dental Clinic, 2/F Fanling Health Centre, 2, Pik Fung Road, Fanling, N.T., Hong Kong. E-mail: rony_cho@dh.gov.hk

dental anomalies, and some of these anomalies were only seen incidentally in the radiographs. It was therefore decided to review the dental records of those children with dens evaginatus, in order to study the prevalence of these concomitant anomalies, and to see if any association of dental anomalies could be identified. The radiographs and dental records of the 10–15 year old children and adolescents attending the clinic in year 2004 were reviewed. The records were selected for study if they met the following criteria:

1 At least one of the premolars was diagnosed of dens evaginatus.
2 Good quality orthopantomograms taken within 12 months were available.
3 The patient was ethnic Chinese.
4 The patient had not been diagnosed with any systemic syndrome.

The demographic data of those selected patients were recorded, as well as the number and distribution of premolars with dens evaginatus. The number and distribution of unerupted premolars in the patients were also noted. The radiographs of the patients were first examined by one paediatric dentist (YK or VC) for concomitant developmental dental anomalies. The chief author (SYC) finally reviewed all radiographs and the findings of the two radiographic examinations were compared for discrepancies. The dental records were also reviewed to check for previously treated dental anomalies not shown in the orthopantomograms. The prevalence of developmental dental anomalies found in this study population was compared with the findings from previous studies on Hong Kong Chinese children. The differences in prevalence were tested using the chi-squared test, and were considered significant if $P < 0{\cdot}05$. Alternatively, Fisher's exact test would be used if the number of cases involved was too small.

Results

A total of 7102 dental records were reviewed and 448 (6·3%) children were found to have one or more premolars with dens evaginatus. All the 448 children met the selection criteria as orthopantomograms were normally taken for patients with dens evaginatus. The male to female ratio was 1:1·2. The patients' age ranged from 10 to 15 years, and most children (82%) were in the age groups of 11- and 12-year-olds, at the time of dental examination. A total of 1018 premolars with dens evaginatus were diagnosed in these 448 patients and 72% of them were mandibular premolars (Table 1). The left-to-right ratio was 1 : 1. One hundred and forty-one children had one or more unerupted premolars. Of the 448 selected records, concomitant dental anomalies were found in 77 children (17·2%). (Table 2) The most commonly encountered anomalies were hypodontia, hyperdontia, impacted teeth, and microdontic maxillary lateral incisors. Eight children had more than one concomitant anomaly in addition to dens evaginatus. When comparing the results of the two evaluations, a complete accordance was found. Twenty percent of the radiographs were re-examined by the first author (SYC) 1 month after the original analysis, and a reproducibility of 100% was found in the identification of concomitant dental anomalies.

Among the 20 patients with hypodontia, 17 had only one to two teeth missing. The teeth most commonly affected by agenesis were mandibular incisors, followed by second premolars (third molars excluded). Maxillary lateral incisors were found to be missing in only two children. Of the 18 patients with supernumeraries, premaxillas were the only affected areas in 10 cases. Four children had supernumerary premolars, two had maxillary paramolars,

Table 1. Distribution of dens evaginatus in premolars.

Teeth affected	No. (right)	No. (left)	Subtotal
Maxillary first premolars	81	105	186
Maxillary second premolars	48	52	100
Mandibular first premolars	173	153	326
Mandibular second premolars	204	202	406
Total:	506	512	1018

Table 2. Concomitant dental anomalies diagnosed in children with dens evaginatus.

Concomitant dental anomalies	No. of cases diagnosed*	Prevalence (%)
Hypodontia	20	4·46
Supernumerary teeth	18	4·02
Dental impaction	17	3·79
Microdontic maxillary lateral incisors	16	3·57
Transposed maxillary canines/premolars	5	1·12
Dens invagination	4	0·89
Double tooth	3	0·67
Odontomes	2	0·45
Odontogenic cyst	1	0·22

*Seven and one children had two and three concomitant anomalies, respectively.

Table 3. Prevalence of developmental dental anomalies in this and previous studies [6,9].

Dental anomalies	Prevalence in this study (%)	Prevalence in 12-year-old Hong Kong Chinese children (%)	Statistical analysis (chi-squared test with Yates's correction)
Hypodontia	4·5	6·9 [9]	$P > 0{\cdot}05$
Supernumerary teeth	4·0	2·7 [9]	$P > 0{\cdot}1$
Dental impaction	3·8	N/A*	N/A
Microdontic maxillary lateral incisors	3·6	3·3 [6]	$P > 0{\cdot}5$

*Data on Hong Kong Chinese children not available.

and one had a supernumerary fused to a mandibular canine. Only one case with multiple supernumeraries was seen: a supernumerary premolar and a paramolar in the left mandible, with history of extraction of mesiodens at an earlier age. Seventeen patients showed dental impaction: maxillary canines (three cases), mandibular canines (four cases), maxillary second premolars (three cases), and mandibular second molars (seven cases). Other concomitant anomalies seen in this study included microdontic maxillary lateral incisors, transposition of maxillary canines and first premolars, dens invagination in maxillary lateral incisors, fusion of mandibular incisors/canines, odontomes, and an odontogenic keratocyst.

The prevalence of the four most commonly seen developmental anomalies in this study population was compared with the findings from previous studies on 12-year-old Hong Kong Chinese children [6,9], and the results were summarized in Table 3. The children with dens evaginatus were less commonly affected by hypodontia than children in the general population, but the difference was not statistically significant (chi-squared test, $P > 0{\cdot}05$). The pattern of hypodontia was also similar to that seen in previous studies where mandibular permanent incisors were most frequently found missing, followed by second premolars. The prevalence of supernumerary teeth found in this study was higher than that observed in previous studies, but again the difference was not statistically significant (chi-squared test $P > 0{\cdot}1$). However, when analysed separately, the proportion of children affected by supernumerary premolars was much greater than that seen in the previous study [9]. Davis found the prevalence of premaxillary supernumeraries, paramolars, and supernumerary premolars in 12-year-old Hong Kong Chinese children to be 2·4%, 0·27%, and 0·09%, respectively [9]. In this study, the corresponding figures were 2·5%, 0·67%, and 1·1%, respectively. There was a 12-fold difference in the prevalence of supernumerary premolars between the two study populations, and the difference was statistically significant (Fisher's exact test, $P < 0{\cdot}01$).

Discussion

Most children included in this study were 11–12 years of age. Bedi and Pitt considered this the most suitable age group, as most premolars were erupting or had recently erupted. The chance of having a small evagination worn away, giving a false-negative recording could therefore be minimized [5]. The prevalence of dens evaginatus in this study was 6·3%, which was higher than those found in previous studies on Chinese children [4–6]. A probable reason was that the children in this study were examined under optimal dental setting that made identification of small tubercle easier than in field studies. More mandibular premolars were found to be affected by dens evaginatus in this study, which concurred with the findings from previous studies [1,2,4,5].

In this study population, the most commonly seen concomitant developmental dental anomalies were hypodontia, hyperdontia, microdontic maxillary lateral incisors, and dental impaction. There was not any published data on the prevalence of dental impaction in Hong Kong Chinese children and so a direct comparison could not be made. Regarding the other anomalies, the prevalence of supernumerary premolars was found to be significantly higher in children with dens evaginatus than in the general population, which suggested a possible association of the two anomalies.

Supernumerary premolars have been reported to represent 6–11% of all supernumerary teeth [10–12]. Only a few studies have reported the prevalence of supernumerary premolars, which was found to be 0·09% in Hong Kong Chinese [9], and less than 0·3% in Caucasian [13,14]. More recently, Rubenstein *et al.* have identified seven cases of supernumerary premolars in an orthodontic clinic and they estimated the prevalence to be 0·64% [15]. This was higher than those found in previous studies and one of the reasons may be that most of their patients were followed up longitudinally and serial orthopantomograms were available. As a result, the authors were able to detect the cases with delayed formation of supernumerary premolars. In this study, there may be some children with developing germs of supernumerary premolars who were not diagnosed at their present ages. As these teeth generally develop on the lingual side of the normal premolars, the developing crypts in young patients may be masked by the roots of the normal premolars, making the early detection on routine radiographs difficult [16].

The exact mechanisms leading to hypodontia, hyperdontia, and dens evaginatus are not clear, but the higher incidences of these anomalies among first-degree relatives of the affected individuals than in the general population suggest a significant genetic component in the aetiology [17,18]. It is generally agreed that control of the complex processes of odontogenesis is primarily polygenetic [19,20], although environmental factors could not be ruled out [17]. More than 200 genes have already been identified to have various roles in the control of tooth development [20]. Several families of secreted signal molecules, such as tumour necrosis factors (TNF) and sonic hedgehog (SHH), have been found to be involved in different stages in odontogenesis [19–22]. Interaction of these signal molecules during early stages of tooth development would determine the final location, size, and shape of the future teeth.

Ectodysplasin, a signal molecule of the TNF family, is expressed in dental placodes at the initiation of tooth development, and it also regulates the functions of the enamel knots [22,23]. The enamel knots have recently been found to be important signalling centres in odontogenesis, and they would determine the number, location, and size of the tooth cusps [24]. In animal experiments, overexpression of ectodysplasin in mice would result in the formation of additional cusps in molars, and about 50% of these mice also developed supernumerary teeth [23]. Interestingly, these supernumerary teeth erupted anterior to the first molars and had morphology similar to premolars of other rodent groups, despite the fact that mice normally did not have premolars. We postulate that ectodysplasin, and possibly other related signal molecules, may be overexpressed in various degrees in the premolar regions in children with dens evaginatus. The fact that only a small proportion of children with dens evaginatus develop supernumerary premolars suggests that other factors are also involved. The degree and timing of the ectodysplasin overexpression, compensatory decrease of down-stream targets in the pathway, and the degree of expression of ectodysplasin receptor in the remnant of dental lamina may all play a role in determining the final phenotype. Other signal molecules such as SHH, which has a key function in controlling the formation of successional teeth [25,26], may also be involved in the pathogenesis.

What this paper adds

- This paper reports the prevalence of various concomitant developmental dental anomalies in Chinese children with dens evaginatus.
- There may be an association of supernumerary premolars with dens evaginatus in Chinese children.

Why this paper is important to paediatric dentists

- Early detection of concomitant developmental anomalies in children with dens evaginatus may allow early intervention and possibly better prognosis.

Conclusion

1 Supernumerary premolars appeared to be more prevalent in Chinese children with dens evaginatus than in the general population.
2 There may be a possible association of supernumerary premolars with dens evaginatus in this study population.

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