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The relationship between a primary maxillary incisor with a talon cusp and the permanent successor: a study of 57 cases

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Background. Most reported cases of talon cusps in the primary dentition have been on the maxillary central incisors and the permanent successors have remained unaffected. Four of the five reported cases on a maxillary lateral incisor, however, have been associated with a supernumerary permanent successor.

Aim. This paper describes the relationship between the presence of talon cusps on a primary maxillary incisor, and the morphology and number of the permanent successors in a population of Chinese children.

Design. The dental records of children diagnosed with a talon cusp on a primary incisor were retrieved for review. The diagnoses took place in a regional school dental clinic in Hong Kong between April 2002 and August 2005.

Results. Fifty-eight primary maxillary incisors with talon cusps were found. When the central incisors were involved, 32 of the 35 (91.4%) underlying permanent successors were not found to be associated with any odontogenic abnormalities. When the lateral incisors were involved, however, 18 of the 23 cases (78.3%) showed odontogenic abnormalities, 14 of which were associated with supernumerary teeth.

Conclusions. The present study shows that, when there is a talon cusp on a primary maxillary lateral incisor, a high proportion of the underlying permanent successors can be expected to exhibit odontogenic abnormalities.

Introduction

The term 'talon cusp', so called because this feature resembles an eagle's talon in shape, was first used to define a cusp-like structure projecting from the cingulum area of a maxillary or mandibular incisor of variable length that may extend past the incisal edge of the tooth[1]. The diverse clinical manifestations of the anomaly, have led talon cusp to be described in many different ways; for example, supernumerary cusp, horn, hyperplastic cingulum, evaginated odontome, cusped cingulum, accessory cusp, dens evaginatus and supernumerary lingual tubercle. Because there is a lack of strict diagnostic criteria with which to define talon cusp, Mader suggested that the term should be reserved to describe only those anomalous cusps of succedaneous incisor teeth that: project prominently from the lingual surface of the tooth; are morphologically well delineated; and extend at least half the distance from the cemento-enamel junction to the incisal edge. Lesser cusp-like formations in the cingulum area of succedaneous incisor teeth should be referred to as 'enlarged cingula' or 'prominent cingula'[2]. Subsequently, a more detailed classification of the anomaly into true talon (type 1), semi-talon (type 2) and trace talon (type 3) was proposed[3]. After the reporting of a facial talon cusp[4], and both facial and palatal cusps on the same tooth[5,6], the classification was modified to include these rare presentations and to define the extension of the cusp more precisely[6,7].

When Mellor and Ripa first coined the term 'talon cusp', they stated that it was an unusual and relatively rare anomaly that had only been reported in the permanent dentition[1]. Since the first report of a talon cusp on a primary incisor of a mummified child appeared in the English literature in 1976[8], however,

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more than 30 cases have been reported[9]. The prevalence of talon cusp has been frequently reported in the permanent dentition, but seldom in the primary dentition. A prevalence study involving Japanese children reported that the prevalence in the primary dentition was 0.6%, while that in the permanent dentition it was 0.9%[10]. Although it has been reported that the permanent teeth are affected three times more frequently than primary teeth[11], it has also been suggested that the prevalence of talon cusp in the primary dentition may not actually be lower than that in the permanent dentition[12,13].

The fact that talon cusps mostly affect the maxillary lateral incisors in the permanent dentition and the maxillary central incisors in the primary dentition may suggest that the aetiological factors responsible for the formation of talon cusps on permanent and primary teeth are different[7]. Moreover, some authors have stated that a talon cusp in the primary dentition will not affect the permanent dentition, further suggesting that the aetiologies may be different[8,12,14]. To date, there have been 37 documented cases of talon cusps on the primary incisors of normal children; 31 cases involved maxillary central incisors, either unilaterally or bilaterally distributed, one case was found on the mandibular lateral incisor, while five cases were identified on the maxillary lateral incisors. There was only one case with a talon cusp on a primary left maxillary central incisor that was associated with an inverted supernumerary tooth in the contralateral central incisor region[12]. Eighty per cent of the cases with a talon cusp on a primary maxillary lateral incisor, however, were associated with supernumerary permanent successors[9,15–17]. This paper aims to describe the relationship between the presence of talon cusps on a primary maxillary incisor, and the morphology and number of the permanent successors in a population of Chinese children.

Materials and methods

The dental records of children diagnosed with a talon cusp on a primary incisor were retrieved for review. The diagnoses had been made between April 2002 and August 2005 in a regional school dental clinic in Hong Kong. The subjects were included in the study if they were ethnically Chinese, unaffected by a syndrome and the dental record included a good-quality intraoral radiograph, either a periapical or an anterior occlusal radiograph, of the involved tooth. The type of talon cusp, the tooth involved, the gender of the child, and the number and shape of the permanent successor teeth as seen on the radiographs were recorded.

The type of talon cusp was determined according to the classification proposed by Hattab *et al.*[3], as modified by Jeevarathan *et al.*[6]: Type 1 (major) talon cusp is defined as a morphologically well-defined additional cusp that projects from the facial and/or palatal/lingual surface of an anterior tooth, and extends at least half the distance from the cemento-enamel junction to the incisor edge. Type 2 (minor) talon cusp is a morphologically well-defined additional cusp that projects from the facial and/or palatal/lingual surface of an anterior tooth, and extends more than one-fourth, but less than half, the distance from the cemento-enamel junction to the incisal edge. Type 3 (trace) talon cusp is an enlarged or prominent cingulum and its variations that occupies less than one-fourth of the distance from the cemento-enamel junction to the incisal edge.

Results

A total of 57 subjects with a talon cusp on a primary incisor were included in the study, and 34 cases involved the primary maxillary central incisors. Sixteen cases involved the right central incisor only (male:female ratio = 10:6), 17 involved only the left central incisor (male:female ratio = 12:5) and one case involved both central incisors (Table 1). There were 23 cases with talon cusps on the primary lateral incisor, 17 with talon cusps on the right lateral incisor (male:female ratio = 10:7) and six cases with talon cusps on the left lateral incisor (male:female ratio = 4:2). Regarding the type of talon cusp, 40 of the 58 teeth, 27 central and 13 lateral incisors, had type 1 talon cusp; 10 teeth, five central and five lateral incisors, had type 2; while the other eight, three central and five lateral incisors, could not be classified because of attrition or caries. The effect of the

Table 1. Summary of the 57 cases of talon cusps reported in this study.

Case	Gender	Tooth	Talon type	Permanent successor	Odontogenic anomaly at anterior maxilla
1	M	51	Attrited cusp	Normal	Supplemental 52
2	M	51	Attrited cusp	Normal	No
3	M	51	2	Normal	No
4–10	M	51	1	Normal	No
11	F	51	1	Incisiform non-inverted supernumerary tooth	No
12	F	51	1	Normal	12 minor talon cusp
13	F	51	Caries	Normal	Missing 12, 22
14–16	F	51	1	Normal	No
17*	M	61	1	Small, barrel-shaped supernumerary tooth erupted on palatal side of 61	No
18*	M	61	1	Inverted conical supernumerary tooth	No
19	M	61	1	Normal	Inverted conical supernumerary tooth at 51 region
20–21	M	61	1	Normal	Missing 13, 23 (twins)
22	M	61	2	Normal	No
23–28	M	61	1	Normal	No
29–30	F	61	2	Normal	No
31–33	F	61	1	Normal	No
34	M	51, 61	1, 1	Normal	No
35	M	52	1	Supplemental 12	No
36	M	52	1	Microdontic 12	Microdontic 22 with dens invaginatus
37	M	52	1	Peg-shaped supernumerary tooth	No
38*	M	52	1	Supplemental 12	22 type 2 (minor) talon cusp
39	M	52	1	One conical-shaped, one tuberculated	22 with dens invaginatus
40	M	52	1	Small supernumerary tooth mesial to 12, delayed eruption of 11	No
41	M	52	1	Normal	No
42	M	52	2	12 with talon cusp	No
43	M	52	2	Supplemental 12	No
44	M	52	Caries	Supplemental 12, distal one with talon cusp	No
45	F	52	1	Supplemental 12	No
46	F	52	1	Supplemental 12, distal one smaller	No
47	F	52	1	Normal	No
48	F	52	2	Missing 12	Odontome at 11 region
49	F	52	Attrited cusp	Microdontic 12	No
50–51	F	52	Attrited cusp	Supplemental 12	No
52	M	62	1	Supplemental 22, distal one smaller	No
53	M	62	1	Normal	Double 51–52, missing 12
54	M	62	2	Normal	No
55*	M	62	2	Supplemental 22	No
56*	F	62	1	Peg-shaped supernumerary tooth	No
57	F	62	Attrited cusp	Normal	No

*Cases shown in the figures: 17 (Fig. 1), 18 (Fig. 2), 38 (Figs 3 & 4), 55 (Fig. 5) and 56 (Fig. 6).

type of talon cusp on the permanent successor could not be ascertained as a result of the relatively small sample size of the type 2 talon cusp.

The relationships between the primary incisors that had a talon cusp and their permanent successors are summarized in Table 2. When the talon cusps were on the primary maxillary central incisors, 32 of the 35 (91.4%) underlying permanent successors were unassociated with any odontogenic abnormalities and the remaining three cases were associated with supernumerary teeth in the corresponding region, one being inverted (case 18) and two noninverted (cases 11 and 17). When the talon cusps were on the primary maxillary lateral incisors, however, 18 of the 23 cases (78.3%) showed odontogenic abnormalities. One individual had a missing permanent successor (case 48), another had a talon cusp on the permanent successor (case 42), while the permanent successors of two more were

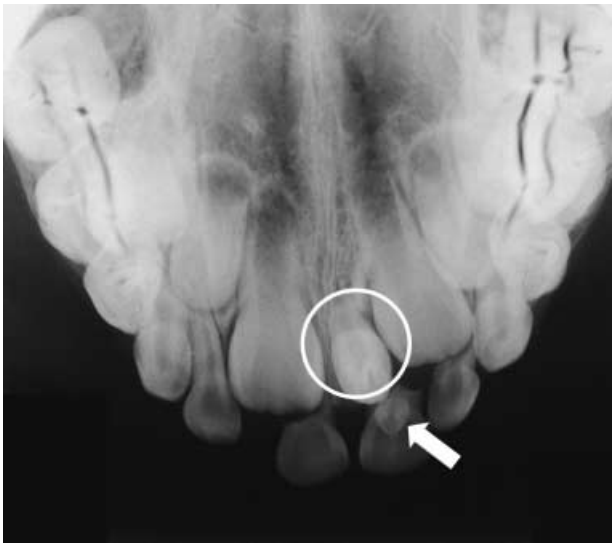

Fig. 1. Case 17: a barrel-shaped supernumerary tooth (circled) located palatal to tooth 61, which has a talon cusp (arrow).

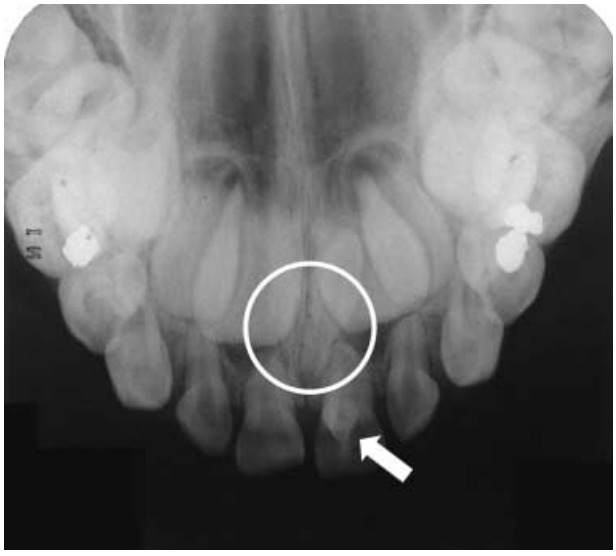

Fig. 2. Case 18: a talon cusp on tooth 61 (arrow) and an inverted conical supernumerary tooth (circled).

Table 2. Relationships between primary incisors with talon cusp and their permanent successors.

Primary incisor	Permanent successor	Primary incisor
Maxillary central incisor ($n = 35$*)	Supernumerary tooth ($n = 3$)	51 ($n = 1$) 61 ($n = 2$)
	Normal ($n = 32$*)	51 ($n = 16$)* 61 ($n = 16$)*
	Supernumerary tooth ($n = 14$)	52 ($n = 11$) 62 ($n = 3$)
	Talon cusp ($n = 1$)	52 ($n = 1$)
Maxillary lateral incisor ($n = 23$)	Normal ($n = 5$)	52 ($n = 2$) 62 ($n = 3$)
	Microdontic ($n = 2$)	52 ($n = 2$)
	Missing ($n = 1$)	52 ($n = 1$)

*Case 34: both central incisors involved, therefore counted separately.

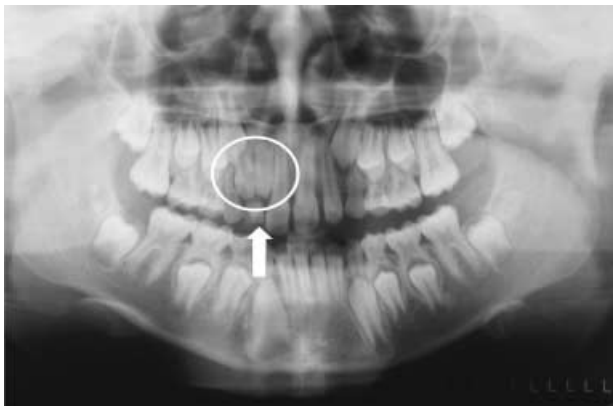

Fig. 3. Case 38: a talon cusp on tooth 52 (arrow), which is associated with a supplemental permanent lateral incisor (circled).

microdontic (cases 36 and 49). The remaining 14 cases (60.9%) were associated with supernumerary teeth in the proximity of the permanent successor. Among these 14 cases, 10 had two permanent lateral incisors that were similar in morphology, and four had a normal permanent lateral incisor and a conical supernumerary tooth (cases 37, 39, 40 and 56).

Discussion

Of the 37 cases of a talon cusp in the primary dentition of normal children documented in the English literature, 20 were Chinese, seven Asians, seven non-Asians and the ethnic origin of three cases was not specified. In this study, which reports 57 new cases, all of whom were ethnically Chinese, the male:female ratio of a talon cusp in the primary dentition was 37:20, which is similar to the ratio of 21:11 reported from all the cases in the literature. The higher male predilection may suggest a sex-linked genetic component in the aetiology of talon cusp in the primary dentition.

In this study, there was only one case of talon cusps occurring bilaterally on the maxillary

Fig. 4. Case 38: an occlusal view showing a type 1 talon cusp on tooth 52 (arrow) and a type 2 talon cusp on tooth 22 (arrow).

Fig. 5. Case 55: a type 2 talon cusp on tooth 62 (arrow) and a supplemental permanent lateral incisor (circled).

central incisors, while 13 such cases have been reported in the literature[9]. This may be a result of the fact that the more common unilateral cases have been under-reported, which is concordant with the suggestion that the prevalence of a talon cusp in the primary dentition may not be lower than that in the permanent dentition[12,13]. In the previous reports of unilateral involvement of talon cusps on the primary maxillary incisors, which included seven right central (tooth 51), 11 left central (tooth 61), three right lateral (tooth 52) and two left lateral incisors (tooth 62), there was no significant difference between left and right side distribution. In this study, there was also no significant difference between the left and right side distribution of talon cusps on the central incisors: 17 were on the left and 16 on the right central incisors. The marked difference in the distribution of talon cusps on the lateral incisors, six on the left and 17 on the right

Fig. 6. Case 56: an occlusal radiograph showing a talon cusp on tooth 62 (arrow) and a peg-shaped supernumerary tooth (circled).

lateral incisors, warrants further investigation involving a larger sample, however.

Among the 31 cases of talon cusps on the primary maxillary central incisors reported in the earlier studies, there was no odontogenic abnormality affecting the corresponding permanent successor, except for one case of an inverted conical supernumerary tooth that was found in relation to the contralateral central incisor[12]. This may be because the condition of the permanent successor was not specified or the patient was too young to permit a definitive diagnosis in 24 of these reported cases. In this study, the condition of the permanent successors was confirmed using radiographs. In addition, the subjects were at least 6 years of age, which permitted an accurate diagnosis of the presence of a supernumerary tooth. Three subjects (cases 11, 17 and 18) among the 34 cases with talon cusp on the primary maxillary central incisors in this study had supernumerary teeth associated with the permanent successors. The morphology of the supernumerary teeth in cases 17 and 18 were barrel-shaped and conical-shaped, respectively, which is similar to that of most supernumerary teeth found in the anterior maxillary region. In case 11, however, the incisiform supernumerary tooth was only slightly smaller than the adjacent central incisors. In case 19, there was an inverted conical supernumerary tooth associated with the contralateral permanent

central incisor, a finding similar to a previously reported case[12]. A total of four cases of supernumerary teeth in the anterior region of the maxilla in this sample of 34 cases (11.8%) represents a prevalence that is higher than the 2.4% for a group of 1093, 12-year-old schoolchildren from the same geographical region[18]. The small sample size of 34 cases may have produced a biased prevalence figure, however. Moreover, the sample in this involved younger children, mostly between 6 and 8 years of age, who may have a higher prevalence for supernumerary teeth since most supernumerary teeth, especially those causing delayed eruption or impaction of the permanent maxillary incisors, would have been removed before 12 years of age.

In the literature, only five cases of a talon cusp on the primary maxillary lateral incisors have been reported. One report did not mention the condition of the permanent successor[19], one case was associated with a supernumerary tooth[9], while the other three cases were associated with supplemental permanent lateral incisors[15–17]. Among the 23 cases of a talon cusp on a maxillary primary lateral incisor in this study, the permanent successors were affected in a completely different way, with a congenitally missing successor at one end of the scale and a supplemental successor at the other end. Only five cases (21.7%) did not show any odontogenic abnormality and 14 cases (60.9%) had supernumerary teeth, 10 of which had a supplemental permanent lateral incisor. From the findings reported in the literature and the results of this study, it is clear that, when a talon cusp is present on a primary maxillary lateral incisor, the effect on the permanent successor is different from that on a maxillary central incisor.

Although the aetiology of talon cusp remains unclear, the higher male predilection, the apparent ethnic variation, the bilateral involvement in some cases and the association with some genetic disorders suggests a genetic relationship. This is further supported by reports of talon cusps on primary maxillary central incisors affecting two pairs of twins from different families[13], and talon cusps on the permanent incisors in the same family[20], among the siblings[21] and in patients from consanguineous marriages[3,11]. It has also been reported that a child was affected by a talon cusp on a primary maxillary central incisor while his father had the same anomaly on his permanent maxillary lateral incisor[14]. A talon cusp reportedly occurs during the morphodifferentiation stage of tooth formation, resulting from an outward folding of the inner enamel epithelial cells and a transient focal hyperplasia of the mesenchymal dental papilla[11,21]. The talon cusp can be considered to be one end of a range of hyperactivity of the dental lamina, with macrodontia and double tooth in the middle, while the other end is a supernumerary tooth[22]. It is most likely that talon cusp is determined by a multifactorial aetiology, involving both genetic and environmental factors[11,14,23,24]. The authors of this paper believe that the hyperactivity of the primordial cells is genetically determined, but that the degree of hyperactivity is influenced by environmental factors. If the hyperactivity is limited, or only a small proportion of the cells are affected or activated, a tubercle or a talon cusp may result. Although it has been suggested that a talon cusp may be the result of fusion of a normal and a supernumerary tooth[8], the authors of this paper propose that the talon cusp results from the failed separation of a group of hyperactive cells that proliferate from the primordial cell. If the hyperactive cells are sufficiently activated and subsequently separated from the primordial cells, they may form a supernumerary tooth, or even a supplemental tooth. If the hyperactivity is only moderate, or the separation of the hyperactive cell mass is inhibited, a double tooth will be formed. This may also explain the aetiology of a double tooth with a talon cusp on the corresponding tooth in the permanent[11,25,26] and primary dentitions[9].

Several studies have shown that a dental anomaly, such as a double tooth, hypodontia or supernumerary tooth, in the primary incisors will affect the number or morphology of the permanent successors[28–30]. Some investigators, however, have suggested that, when a talon cusp is present in the primary dentition, the permanent dentition will be unaffected[8,12,14]. Recently, there has been a report of a talon cusp on a primary maxillary left lateral incisor

that was associated with a talon cusp on the contralateral permanent lateral incisor[17]. Case 42 in this study showed that both the primary incisor and its permanent successor could be affected by a talon cusp. From the results of this study, it is evident that the morphology and number of a permanent successor can be affected by a talon cusp on the primary predecessor. A talon cusp on a primary maxillary central or a lateral incisor, however, has a different effect on the corresponding permanent successor, particularly with respect to the number of successors. This may be related to the time when the primordial cell or the tooth germ of the primary maxillary incisor receives or is affected by the hyperactivity signalling mechanism. If this is earlier than the formation of the primordial permanent successor, the permanent successor will acquire the potential for hyperactivity. If the primordial permanent successor has started to form before the 'signal' is released, however, the permanent successor will be unaffected. The permanent maxillary lateral incisor is the last tooth in the region of anterior maxilla to form, and this may explain why the permanent maxillary lateral incisor is so commonly affected.

In conclusion, when there is a talon cusp on a primary maxillary lateral incisor, there is a high chance that the underlying permanent successors will exhibit an odontogenic abnormality, the most frequent of which is a supernumerary permanent successor, which is mostly supplemental in nature. Therefore, clinicians should be aware of this potential relationship, and implement early screening and diagnosis.

What this paper adds

- A talon cusp on a primary maxillary lateral incisor may not be as rare as previously reported.
- A talon cusp on a primary maxillary incisor, especially the lateral incisor, may affect the number or morphology of the permanent successor(s).

Why this paper is important to paediatric dentists

- Paediatric dentists should screen and identify affected children at an early age so that, when an odontogenic abnormality of the permanent successor is found, a comprehensive treatment plan can be formulated as soon as possible.

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