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Case Report

Two non-syndromic cases of multiple supernumerary teeth with different characteristics and a review of the literature

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ABSTRACT

Multiple supernumerary teeth are rare in patients without any associated conditions, and the mechanisms responsible for the development of multiple supernumerary teeth in such patients remain unclear. We report two cases in which multiple supernumerary teeth developed in patients without any associated conditions. The two cases differed with respect to the morphology of the supernumerary teeth, the locations of impacted teeth, and the degree of calcification and development of the supernumerary teeth. Case 1 involved a 13-year-old boy with six impacted supernumerary teeth who was not suffering from any associated conditions. The supernumerary teeth were impacted on the lingual or palatal side of the premolars and canine root apex, were similar in size, and exhibited similar degrees of calcification and development. Case 2 involved a 10-year-old boy without any relevant medical history who had five impacted supernumerary teeth. His supernumerary teeth were distributed in an irregular manner and varied in size, morphology, and the extent of their calcification and development. Genetically modified mouse models have provided some information about the molecular mechanisms underlying the development of supernumerary teeth. We reviewed previous cases of non-syndromic multiple supernumerary teeth based on our findings. We consider that supernumerary teeth can arise via various developmental mechanisms and that similar developmental mechanisms to those seen in mouse models might exist in humans.

1. Introduction

Supernumerary teeth are teeth that form in addition to the normal dental formula [1]. Most cases involve a single supernumerary tooth, but multiple supernumerary teeth develop in some cases. In addition, they can occur unilaterally or bilaterally and can arise in the maxilla, mandible, or both [2]. Their overall prevalence ranges from 0.1% to 3.6%; however, it varies between the races [3]. The reported prevalence in Caucasian and Mongoloid populations was less than and greater than 3%, respectively [2,4]. Furthermore, males retain supernumerary teeth approximately twice as often as females [2,5]. Although the occurrence of one or two supernumerary teeth is common (76–86% cases involve one supernumerary tooth; 12–23% cases involve two supernumerary teeth), cases involving greater numbers of supernumerary teeth are rare (≥3 teeth develop in 2–8% cases) [2,6–8]. In fact, <1% of cases involve ≥5 supernumerary teeth [9,10].

In most cases, multiple supernumerary teeth occur as a symptom of a developmental disorder, such as cleft lip and palate, cleidocranial dysplasia (CCD), familial adenomatous polyposis, or Gardner's syndrome. Other syndromes that are associated with the development of multiple supernumerary teeth include Ehlers–Danlos syndrome, Nance–Horan syndrome, Fabry syndrome, Ellis–van Creveld syndrome (chondroectodermal dysplasia), trichorhinophalangeal syndrome, and Robinow syndrome [2,6]. In addition, the following genes have been found to be associated with the above-mentioned syndromes: CCD: RUNX2 (OMIM 600211); familial adenomatous polyposis, including Gardner's syndrome: APC (OMIM 611731); Ehlers–Danlos syndrome type III: tenascin-XB (OMIM 600985) and COL3A1 (OMIM 120180);

☆ AsianAOMS: Asian Association of Oral and Maxillofacial Surgeons; ASOMP: Asian Society of Oral and Maxillofacial Pathology; JSOP: Japanese Society of Oral Pathology; JSOMS: Japanese Society of Oral and Maxillofacial Surgeons; JSOM: Japanese Society of Oral Medicine; JAMI: Japanese Academy of Maxillofacial Implants.

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Nance–Horan syndrome: NHS (OMIM 300457); Fabry syndrome: GLA (OMIM 300644); Ellis–van Creveld syndrome: EVC (OMIM 604831) and EVC2 (OMIM 607261); trichorhinophalangeal syndrome: TRPS1 (OMIM 604386); and Robinow syndrome: ROR2 (OMIM 602337). In recent studies, we have also detected prospective signs of CCD in CEBPB (OMIM 189965)-deficient mice [11,12]. It is rare to find multiple supernumerary teeth in patients without any systemic conditions or associated syndromes [3], and the mechanisms underlying the development of supernumerary tooth in such patients remain unclear, although genetic factors are suspected to be involved.

Recently, many mutant mouse models have yielded insights into supernumerary tooth formation [13], and several mechanisms have been proposed [14,15]. One plausible explanation is the rescue of tooth rudiments, such as those within the diastema region or maxillary deciduous incisors [16,17]. Furthermore, it has been suggested that in humans, a 'third dentition' involving one or more supernumerary teeth can develop, i.e., supernumerary teeth may represent a partial post-permanent dentition [18]. Another possible mechanism is that supernumerary teeth formation can be induced on both the labial and lingual sides of the incisors, which contain adult stem cells. These stem cells have been shown to support the continuous growth of mouse incisors [19]. Supernumerary tooth germ formation can be induced in multiple regions of the jaw. For example, supernumerary tooth germs can form directly from the oral epithelium, in the dental lamina connecting the developing molar or incisor tooth germs to the oral epithelium, in the crown region, or in the elongated and furcated regions of developing roots [15,20].

Here, we report two cases of multiple supernumerary teeth that involve in those who were not suffering from any associated conditions. In one case, the supernumerary teeth were located on the lingual or palatal side of the permanent teeth and were arranged in a regular manner. In addition, their calcification and developmental patterns resembled those of a 'third dentition'. We have previously reported this case in brief [13]. In the other case, the supernumerary teeth were arranged irregularly and varied in size, morphology, and the degree of their calcification and development. In addition, the supernumerary teeth arose on both the labial and lingual sides of the incisors and molars. Furthermore, we reviewed previous cases of non-syndromic multiple supernumerary teeth based on our findings. The purpose of this case report is to document two typical cases of non-syndromic multiple supernumerary teeth to improve our understanding of the etiology of human supernumerary tooth formation.

2. Case report

2.1. Case 1

A 13-year-old boy was found to have multiple impacted teeth during a panoramic radiograph examination performed at a dental clinic. He was referred to our hospital for diagnosis and treatment. During an intraoral examination, no abnormalities related to the size or shape of his tooth crowns, the relationship between his dental age and chronological age, or the positions of his erupted teeth were found, but a panoramic radiograph revealed six impacted supernumerary teeth in three quadrants: two in the maxillary right canine and premolar regions, three in the mandibular right premolar region, and one in the mandibular left premolar region (Fig. 1). Computed tomography (CT) confirmed that all of the impacted supernumerary teeth were located on the palatal or lingual side of the premolars or canine root apex, and were similar in size, exhibited similar degrees of calcification and development, and had normal premolar crown shapes (Fig. 2). We examined the patients' immediate family, and none of them had supernumerary teeth. Medical examinations ruled out CCD, familial adenomatous polyposis, Nance–Horan syndrome, trichorhinophalangeal syndrome, Robinow syndrome, Hallermann–Streiff syndrome, Rothmund–Thomson syndrome, and orofaciodigital syndrome I, which are associated with supernumerary teeth [13].

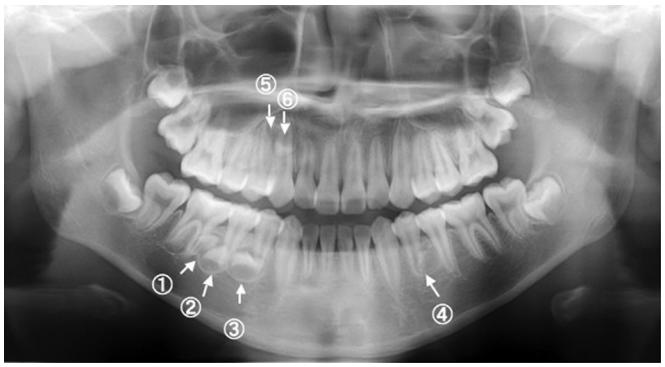

Fig. 1. A panoramic radiograph examination performed in case 1. (1)–(6) are supernumerary teeth (Takahashi et al. [13], copyright, In Tech).

2.2. Case 2

A 10-year-old boy was referred to our hospital for the treatment of multiple impacted supernumerary teeth, which were detected on a dental panoramic radiograph obtained at a dental clinic. An intraoral examination did not detect any abnormalities with regard to the size or shape of the patient's tooth crowns or the relationship between his dental age and chronological age, but a panoramic radiograph revealed multiple supernumerary teeth (Fig. 3). In the maxilla, there were three supernumerary teeth: one each behind the right first molar, behind the right second molar, and below the second deciduous molar. He exhibited delayed exfoliation of the second deciduous molar, so the left second premolar was impacted. In the mandible, there were two supernumerary teeth: one behind the right second molar and one below the right premolar. We confirmed the positional relationships between the impacted supernumerary teeth and the patient's permanent/deciduous teeth using CT (Fig. 4). The five impacted supernumerary teeth were arranged in an irregular manner—the two maxillary right teeth and the tooth behind the mandibular right second molar were impacted on the buccal side of the permanent teeth, the tooth below the mandibular right premolar was impacted on the lingual side of a permanent tooth, and the tooth below the second deciduous molar was impacted on the palatal side of a deciduous tooth. The supernumerary teeth varied in size, morphology, and the extent of their calcification and development. The patient did not have a relevant medical or family history.

3. Discussion

The etiology of supernumerary teeth remains unclear, but various theories have been proposed, including the atavism (evolutionary throwback) or phylogenetic theory, the tooth germ dichotomy theory, and the dental lamina hyperactivity theory. In addition, it has been suggested that genetic and environmental factors might also play a role in the development of supernumerary teeth [6,21]. According to the dental lamina hyperactivity theory, a supplemental form of tooth can arise via the lingual extension of an additional tooth bud, and a rudimentary form of tooth can develop via the proliferation of epithelial remnants of the dental lamina [22]. Furthermore, the Rose theory suggests that if the dental lamina is not reabsorbed it continues to proliferate and produces new

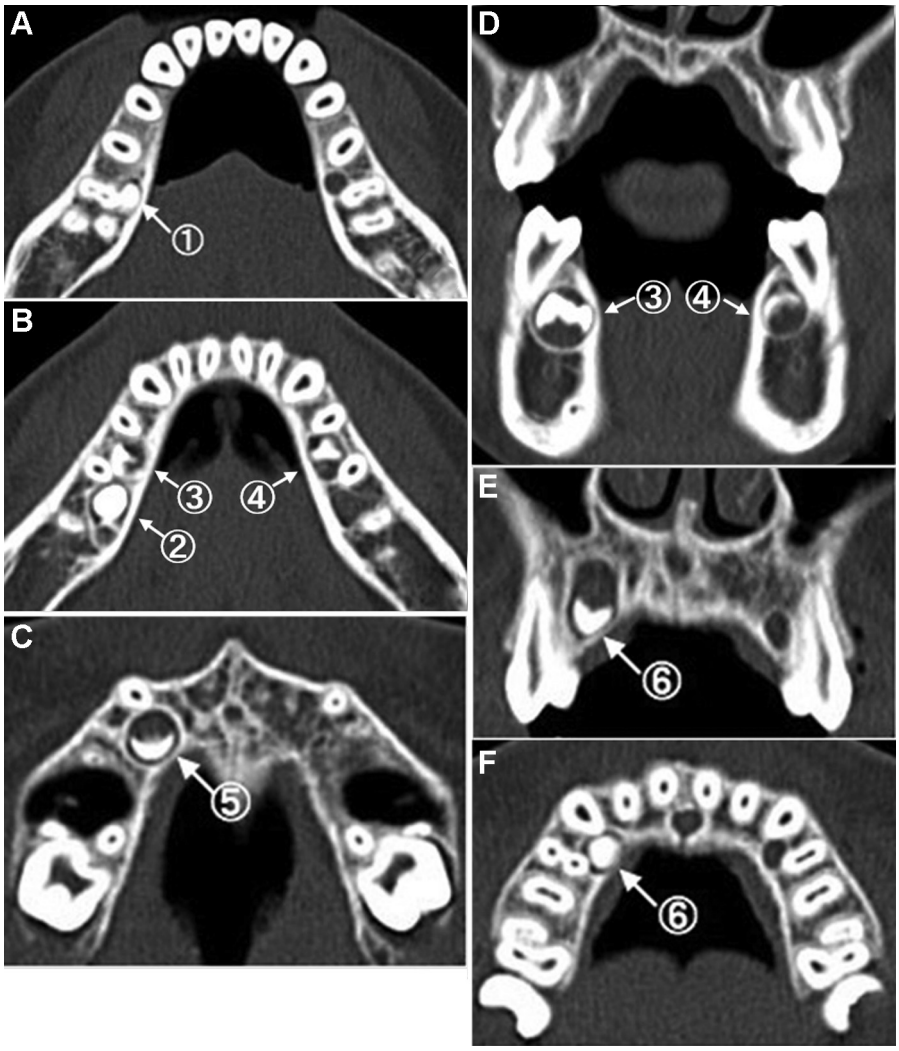

Fig. 2. A computed tomography examination performed in case 1 (A, B, C, F: horizontal view; D, E: frontal view). (1)–(6) are the same supernumerary teeth as in Fig. 1.

normally shaped buds [21,23]. Of the aforementioned theories, the dental lamina hyperactivity theory has attracted the most support in the literature [24].

Non-mammalian vertebrates are polyphyodonts, whereas mammals are diphyodonts. However, humans exhibit diphyodonty of the incisors, canines, and premolars and monophyodonty of the permanent molars; i.e., in each quadrant, two incisors, one canine, and two premolars are only replaced once (when the deciduous teeth are replaced by the permanent teeth). Normal mice are monophydonts and possess one incisor and three molars in each quadrant. The number of teeth possessed by an organism is usually strictly controlled [13,25]. Järvinen et al. reported that in mammals replacement tooth formation involves the growth of the dental lamina from the lingual aspect of the deciduous tooth enamel organ, followed by budding into the jaw, elongation of the successional tooth bud in the cervical direction, and its eventual activation to generate the replacement tooth [25]. The dental lamina is sometimes able to continuously produce teeth [25]. Indeed, replacement teeth form via a similar process in polyphyodont vertebrates, such as fish and reptiles [26,27].

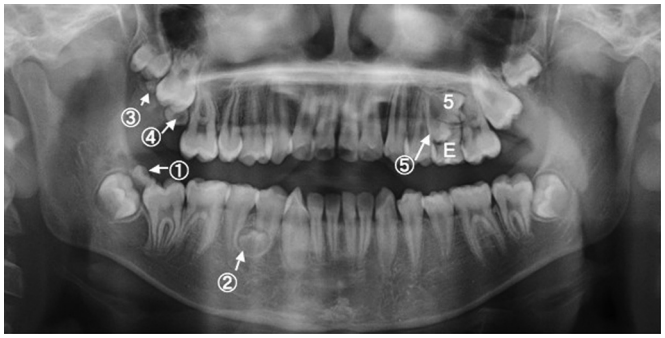

Fig. 3. A panoramic radiograph examination performed in case 2. (1)–(5) are supernumerary teeth. 5: the second left upper premolar; E: the primary molar.

In humans, an epithelial anlage of the third dentition was reported to exist [13]. Ooë found that the epithelium that is considered to act as the anlage of the third dentition develops lingual to all permanent tooth germs [18].

Recently, studies using genetically modified mouse models have attempted to elucidate the molecular mechanisms underlying the formation and development of supernumerary teeth [11,13–15,17,28]. We previously reported that supernumerary teeth form as a result of the successive development of the dental lamina and tooth germ, which initially degenerate and disappear [13,14,17]. On the other hand, Wang et al. suggested that supernumerary teeth form from odontogenic epithelial stem cells in the outer enamel epithelium via epithelial–mesenchymal interactions [15]. In the former mechanism, because the dental lamina extends to the lingual side of the normal teeth, supernumerary teeth can form on the lingual or palatal side of the normal teeth; however,

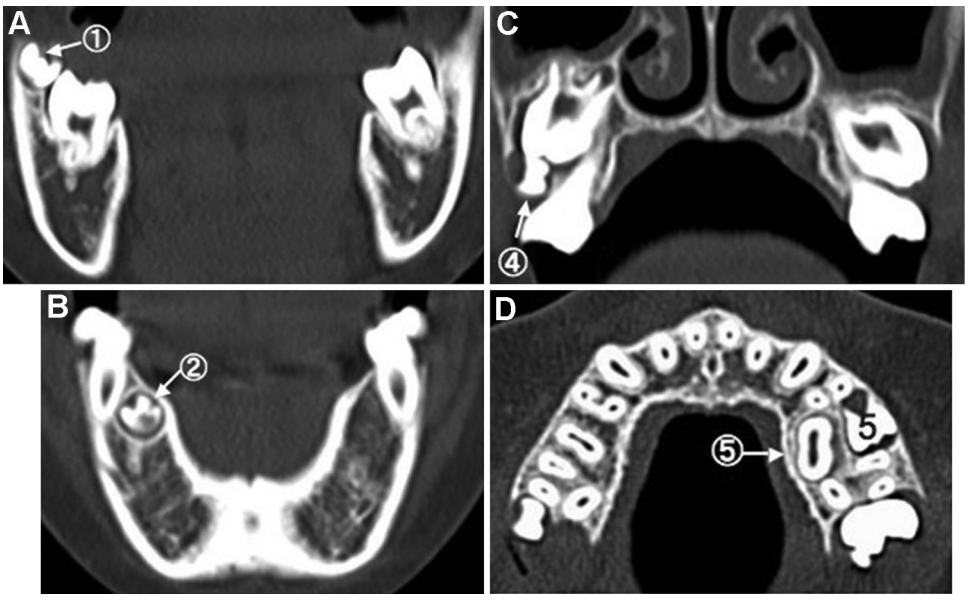

Fig. 4. A computed tomography examination performed in case 2 (A, B, C: frontal view; D: horizontal view). (1), (2), (4), and (5) are supernumerary teeth. 5: the second left upper premolar indicated in Fig. 3.

in the latter mechanism, the supernumerary teeth can form in any part of the jaw where the outer enamel epithelium is present.

We consider that some of the developmental mechanisms reported in studies involving mouse models might also be in operation in humans. Cases 1 and 2 differed with respect to the morphology of the supernumerary teeth, the locations of the impacted teeth, and the calcification and developmental patterns of the supernumerary teeth. In case 1, the supernumerary teeth exhibited

Table 1
The summary of non-syndromic multiple supernumerary teeth.

Case	Sex	Age	Number	Location	Type	Race	Author	Year
1	F	11	8	PM(2) / PM(2) PM(4)	1	unknown	Poyton GH	1960
2		24	2	PM(2)(Lingual)	1	Chinese	Jones AW	1981
3	M	10	22		2	unknown	Rizzuti N	1997
4	M	25	7	M(1) PM(2)(Palatal) M(2) / PM(1)(Lingual) PM(1)	1	unknown	Desai RS	1998
5	M	36	16	TM(1)(Buccal) M(2) C(1) A(1)(Palatal) PM(1)(Palatal) TM(2) / M(1) PM(3) M(1)	2	unknown		
6	M	18	10	M(1) PM(1)(Palatal) PM(2)(Palatal) M(1) / PM(3) PM(2)(Lingual)	1	caucasian	Hopcraft M	1998
7	F	17	11	PM(1) A(1) PM(1) / PM(3) A(2) PM(3)	3	unknown	Batra P	2005
8	M	12	4	C(1) C(1)(Palatal) / PM(1) PM(1)	1	unknown	Sasaki H	2006
9	M	11	8	PM(1) M(1) / PM(3) PM(3)	3	caucasian	Orhan AI	2006
10	M	11	8	PM(1) A(2) PM(1) / PM(2) PM(2)	1	caucasian		
11	M	27	8	PM(1) A(1) PM(2) / PM(2) PM(2)	1	unknown	Acikgoz A	2006
12	M	20	7	PM(2) PM(2) / PM(1) PM(2)	1	unknown		
13	M	17	5	A(2) / PM(1) PM(2)	3	unknown		
14	M	20	6	PM(1) / PM(2) PM(2)M(1)	1	unknown		
15		13	6	PM(2) / PM(3) PM(1)	1	unknown	Hyun HK	2008
16	W	13	4	PM(2)(Lingual) PM(2)(Lingual)	1	Japanese	Kawashita Y	2009

TM: third molar; M: molar; PM: premolar; C: canine; A: anterior.

similar degrees of calcification and forms, and all of the impacted teeth were located on the palatal or lingual side of the premolars. In this case, the supernumerary teeth might have formed due to the successive development of the dental lamina and tooth germs, which initially degenerate and disappear. In case 2, the morphology and impaction locations of the supernumerary teeth, and the degree of calcification and development differed among the supernumerary teeth, indicating that the supernumerary teeth might have arisen from odontogenic epithelial stem cells in this case.

There have been several case reports about non-syndromic multiple supernumerary teeth (Table 1) [9,29–38]. These reports involved various number of patients with different age profiles. In addition, the locations of the supernumerary teeth and the extent of their calcification and development varied. Therefore, we analyzed these previous cases, focusing on the locations (lingual or palatal side of permanent teeth) and distribution patterns of the supernumerary teeth (regular or irregular) and the extent of their calcification and development, and classified them into three types. Type 1: all supernumerary teeth are located on the lingual or palatal side, are arranged in a regular manner, and exhibit similar degrees of calcification and development. Type 2: the supernumerary teeth are arranged in an irregular pattern and exhibit varying degrees of calcification and development. Type 3: the teeth demonstrate a mixture of type 1 and type 2 features. Of the two cases reported in this study, case 1 belongs to type 1 and case 2 was classified as type 2.

Thus, we consider that supernumerary teeth can form via various developmental mechanisms and that some of the mechanisms identified in mouse models might also be in operation in humans. Specifically, in humans, the etiology of multiple supernumerary teeth probably involves genetic components and such teeth might form from the third dentition and/or from odontogenic epithelial stem cells.

Conflict of interest

No conflicts of interest associated with this study exist.

Acknowledgments

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