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Allergy as a possible predisposing factor for hypodontia

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SUMMARY The aim of this retrospective study was to identify general health problems as potential predisposing factors for hypodontia in a population of Japanese orthodontic patients. The study included 3683 individuals (1312 males and 2371 females, 13–42 years of age; mean, 23 years 7 months). Dental pantomograms (DPTs) were used to diagnose hypodontia. Health histories were obtained through a questionnaire administered by the dentist in charge. The Mantel–Haenszel test was used to determine the significance of the differences in the prevalence of health problems.

The overall frequency of hypodontia was 5.8 per cent. The average number of missing teeth per patient was 1.7. There was a high prevalence of systemic complications, which included allergy, asthma, atopy, and enlarged adenoids associated with hypodontia. Only allergy showed a significant relationship with hypodontia ($P < 0.01$). The environmental aetiology of hypodontia is not yet fully understood. However, based on the results of this retrospective study, predisposing general health problems, especially allergy, seem to be involved.

Introduction

Hypodontia, which is the congenital absence of one or more teeth, entails alterations to the human dentition. The most frequently missing permanent teeth are the third molars (20.0 per cent), followed by the second premolars (3.4 per cent), and the maxillary lateral incisors (2.2 per cent) (Simons *et al.*, 1993).

There appears to be a multifactorial aetiology to hypodontia, with both genetic and environmental factors playing important roles (Larmour *et al.*, 2005; Ely *et al.*, 2006). The pathogenesis of hypodontia cannot be explained by genetic factors alone since monozygotic twins show discordant expression at a certain frequency with respect to hypodontia (Markovic, 1982). Hypodontia is thought to involve environmental factors, including infection, e.g. rubella (Gullikson, 1975), drugs, such as thalidomide (Speirs, 1965), and irradiation (Berland, 2002), as well as the developmental relationships between the nerves, maxilla, mandible, oral mucosa, supporting tissues, and hard tissues (Kjær *et al.*, 1994; Kjær, 1998). Developmental anomalies, endocrine disturbances, and local factors, including pathology, facial trauma, and medical treatment, have been also linked to hypodontia (Werther and Rothenberger, 1939; Brook, 1984). Although hypodontia may cause masticatory and speech dysfunctions in addition to aesthetic problems, the relationships with environmental factors remain unclear.

The aim of this study was to identify the aetiological factors underlying hypodontia by investigating the general health problems of Japanese orthodontic patients with hypodontia.

Subjects and methods

The study population comprised 3683 patients (1312 males and 2371 females). The records of Japanese orthodontic patients aged between 13 and 42 years and who had attended the orthodontic clinics of Showa University Dental Hospital, Tokyo, Japan in the period from 1985 to 2006 were retrospectively examined. Patients with congenital diseases, such as ectodermal dysplasia, cleft lip or palate, van der Woude syndrome, and Down syndrome, were excluded from the investigation. Subjects who had undergone orthodontic treatment for the extraction of permanent teeth were also excluded. The diagnosis of hypodontia was derived from the dental pantomograms (DPTs) of all the subjects receiving orthodontic treatment for whom the records of routine orthodontic examinations were available. A tooth was judged to be congenitally missing when no mineralization of its crown could be identified on the DPT. To avoid the registration of late mineralized teeth as being congenitally absent, a final DPT evaluation was performed on each patient aged 13 years or older. This criterion was based on the finding of Aasheim and Øgaard (1993) that apart from the third molars, teeth do not mineralize after 12 years of age. The third molars were not included in the present study.

There may be an association between hypodontia and impaction of the maxillary canine teeth (Brin *et al.*, 1986; Mossey *et al.*, 1994; Peck *et al.*, 1996). As the aim of the present study was to investigate the risk factors for hypodontia, other conditions, such as supernumerary, impacted, morphological aberrations, and hypoplastic teeth,

were not recorded, and no distinction was made between the terms 'hypodontia' and 'oligodontia' for the subjects in the present study.

The patient interviews were performed by the dentist in charge using a three-page questionnaire. The questionnaire consisted of questions relating to chief complaints, family history of malocclusion, growth history, habits, and general health problems. In the case of general health problems, the response to 'Have you ever had any systemic diseases?' was used to define a lifetime prevalence of systemic diseases and the physician's diagnosis of health problems based on a 'yes' or 'no' answer. If a patient answered yes, more information on the systemic disease was requested. Symptoms and locations that characterized health problems experienced could be described as occupational health problems. In addition, the questionnaire invited the participants to describe freely their experiences and to relate their reactions.

Input and descriptive analyses of the data were performed using the Microsoft Excel software. The Mantel–Haenszel test was performed using the EPI-Info software developed by the Centers for Disease Control and Prevention (Atlanta, Georgia, USA) to determine the significance of differences in the prevalences of health problems. The threshold for significance was set at 5 per cent. Relative risk was estimated using odds ratios, and in some cases, prevalence ratios, with test-based 95 per cent confidence intervals.

Results

The response rate to the questionnaire was 100 per cent as patient inclusion in the study was based on a diagnosis that required orthodontic treatment. It is possible that retrospective information was biased by knowledge of the diagnosis, leading to memory recall bias (Rothman and Greenland, 1998). However, this is considered to be unlikely as the participants were unaware of the connections with non-specific health problems.

Overall, 215 of 3683 patients were found to have hypodontia after examination of the orthodontic files. Thus, the prevalence of hypodontia was 5.8 per cent. The average number of missing teeth per patient was 1.7. Of the patients with hypodontia, 87 per cent were missing one or two teeth (Table 1). The one patient who was missing eight teeth lacked any congenital disorder.

Table 2 summarizes the basic characteristics of the study subjects. Of the patients who attended the orthodontic clinics and those with hypodontia who contracted an allergy, the majority were female. Bias is unlikely as this study was conducted with all orthodontic patients (with the same examinations) with the purpose of identifying the aetiological factors underlying hypodontia.

The general health problems observed in patients with hypodontia are shown in Table 3. The most frequent health problems included allergy, enlarged adenoids, asthma, and atopy. Mantel–Haenszel tests were used to determine whether the relationship between general health problems and hypodontia was statistically significant (Table 4). There

Table 1 Distributions of numbers of missing teeth among hypodontia patients.

Number of missing teeth	Females		Males		Total	
	n	%	*n*	%	*n*	%
1	57	44.9	41	46.6	98	45.6
2	55	43.3	34	38.6	89	41.4
3	13	10.2	10	11.4	23	10.7
4	2	1.6	0	0.0	2	0.9
5	0	0.0	1	1.1	1	0.5
6	0	0.0	1	1.1	1	0.5
7	0	0.0	0	0.0	0	0.0
8	0	0.0	1	1.1	1	0.5
	127	100.0	88	100.0	215	100.0

Table 2 Characteristics of the study subjects.

	With hypodontia	Without hypodontia
Number of subjects	215	3468
Age (years; median, range)	21, 13–39	24, 13–42
Gender (female/male)	156/59	2244/1224

Table 3 General heath problems of the hypodontia patients.

Health problem*	Number of patients
Allergy†	9
Enlarged adenoids‡	4
Asthma	4
Atopy§	3
Bronchitis	2
Stuffy nose	2
Exudative otitis media	2
Kawasaki's disease	1
Basadow's disease	1
Atelectasis	1
Acute lymphocytic leukaemia	1
Epilepsy	1
Haemangioma	1
Hydrocephalus	1
Infectious mononucleosis	1
Neonatal jaundice	1
Liver cancer	1
Low birth weight	1
Pyloristenosis	1
Rubella	1
Sialolithiasis	1
Varicella	1

*For patients with several diseases, each disease is counted separately.
†'Allergy' includes allergic rhinitis and pollinosis.
‡'Enlarged adenoids' includes extracted adenoids and tonsillar hypertrophy.
§'Atopy' includes atopic dermatitis.

Table 4 Odds ratio (OR) and 95 per cent confidence intervals (95% CI) for outcome parameters.

Health problem	With	With	Without	Without	OR	95% CI	*P* value
Hypodontia	With	Without	With	Without			
At least one health problem*	*n* = 34	*n* = 200	*n* = 181	*n* = 3268	3.07	2.03–4.62	0.000*
Enlarged adenoids†	4	38	211	3430	1.71	0.51–5.07	0.305
Allergy‡	9	54	206	3414	2.76	1.25–5.89	0.004*
Atopy§	3	16	212	3452	3.05	0.70–11.21	0.063
Asthma	4	25	211	3443	2.61	0.76–7.98	0.067

*At least one health problem; listed in Table 3.
†'Enlarged adenoids' includes extracted adenoids and tonsillar hypertrophy.
‡'Allergy' includes allergic rhinitis and pollinosis.
§'Atopy' includes atopic dermatitis.
*$P < 0.01$

was a significant positive correlation between hypodontia and the presence of at least one health problem or allergy. Table 5 summarizes the teeth missing in the hypodontia patients and the associated health problems. No correlation between the type of health problem and the type of tooth affected by hypodontia was found.

Table 5 Tooth types and systemic diseases in the hypodontia patients.

Case number	General health problems		Tooth type*
	First disease	Second disease	
1	Allergy†		12
2	Allergy		12
3	Allergy		42
4	Allergy		42
5	Allergy		45
6	Allergy		31, 41
7	Allergy		32, 42
8	Allergy		32, 42
9	Allergy		35,
10	Asthma		23
11	Asthma		35, 45
12	Asthma		45
13	Atopy‡	Asthma	45
14	Atopy	Exudative otitis media	31, 41
15	Atopy		12, 22
16	Enlarged adenoids§		31
17	Enlarged adenoids		35, 45

*Federation Dentaire International notation.
†Allergy, including allergic nasitis, allergic rhinitis and pollinosis (pollen allergy).
‡Atopy, including atopic dermatitis.
§Enlarged adenoids or extracted adenoids, including tonsillar hypertrophy.

Discussion

There are few published reports on specific environmental influences on hypodontia. In the present study, a significant relationship was observed between allergy and hypodontia. However, there was no significant relationship between hypodontia and other general health problems, such as asthma, atopy, and enlarged adenoids. The term atopy implies an allergic aetiology of asthma (Bellanti, 2006) and asthma or atopy are based on an allergic response, although it is difficult to distinguish these disease states as the severity and pathological condition of an allergic response varies between patients.

The aetiology of hypomineralized molars is based on a retrospective study showing that health problems in infancy, especially respiratory diseases, play an important role (Jalevik *et al.*, 2001). In the present study, there was also a high prevalence of asthma. It is possible that health problems disrupt the formation of teeth due to illness-associated hypoxia, hypocalcaemia, fever, and/or malnutrition.

Interestingly, some reports (Davidovitch, 1995, 1996; Owman-Moll and Kurol, 2000) have suggested a link between allergy and the extent of root resorption. The occurrence of inflammation in the periodontal ligament at an early stage of tooth movement and the presence of activated leucocytes may imply an association between root resorption and certain pathological conditions (Davidovitch *et al.*, 1988).

Nakasato (2005) reported that the percentage of children with hypodontia for the period from 1989 to 1997 was 4.9 per cent. However, this increased rapidly to 11.6 per cent for the period from 1998 to 2004. For the ratio of patients with and without hypodontia in each period at birth, no tendency was found (data not shown), in Polder *et al.* (2004) a meta-analysis of previous epidemiological research, focused on hypodontia. The prevalence of dental agenesis in the period 1936–2002 was significantly higher than in 1971–1980, a period dominated by studies in Scandinavian countries. They suggested that genetic and environmental factors limited to the countries from which samples were studied explained these differences. The remarkable increase in extensive and severe hypomineralization of the permanent first molars that

was also found in children born in 1970, as compared with those born before or after this year, suggests that the dental defects were caused by environmental changes (Koch *et al.*, 1987). To determine the effect of environmental factors on the occurrence of hypodontia over time, large-scale epidemiological studies, including medical examinations, are required. Valuable aetiological data would be generated by comparing the factors that influence the occurrence of hypodontia in different countries.

Conclusions

Although the aetiology of hypodontia is not yet fully understood, especially with respect to environmental factors, the results of this study indicate that health problems, especially those related to allergy, are of importance.

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