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CONGENITALLY MISSING SECOND PERMANENT MOLARS: CASE REPORTS

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ABSTRACT

Congenital tooth absence is a common dental anomaly in humans. Congenital absence of second permanent molars (SPM) is determined by a number of complex interactions between genetic, epigenetic and environmental factors that intervene during the process of dental development. The prevalence of hypodontia in permanent teeth ranges from 4.4% to 13.4% depending on the continent. Among all missing teeth, the prevalence of SPM is very low (lower SPM – 1.8%, upper SPM – 1.5%). Because SPM agenesis is very rare and there are few studies related to this subject in the literature, the aim of the present study was to present five cases of missing SPM associated with the absence of other permanent posterior teeth are presented. Patients with agenesis of SPM showed a significantly disturbed development of their other SPMs. For all presented cases there was an association with the agenesis of the neighbouring third molar while for one case also a nearby premolar was missing. Even if SPM agenesis does not occur frequently, early diagnosis is very important in order to prevent impairment of masticatory function and occlusal dysfunctions.

Key words: second permanent molars, hypodontia, congenital, disturbed development

INTRODUCTION

Congenital tooth absence or selective tooth agenesis is a common dental anomaly in humans and represents the developmental absence of at least one permanent tooth [1]. Hypodontia refers to the absence of one to six teeth excluding the third molars, while oligodontia describes the absence of more than six teeth excluding the third molar. The most severe condition is anodontia which refers to the absence of all teeth [2]. As reported by Khalaf et al., the worldwide prevalence of hypodontia was found to be 6.4% with significant differences by continent. Prevalence of hypodontia was the highest in Africa (13.4%), followed by Europe (7%), Asia (6.3%), Australia (6.3%), North America (5%) and Latin America and Caribbean (4.4%). Hypodontia affected more females than males while the most affected teeth were mandibular second premolars followed by maxillary lateral incisors and maxillary second premolars. Among all missing teeth, the prevalence of missing second permanent molars (SPM) is very low (lower SPM – 1.8%, upper SPM – 1.5%) [3] or, more recently, 2.79% with a lower/upper ratio of 1.70 [4]. Sheikhi et al. [5] revealed that the least commonly missing teeth were first and second molars in both jaws, followed by mandibular canine, which agrees with the results of other studies conducted by Fekonja

et al. [6] and Endo et al. [1].

Hypodontia may occur either as part of a syndrome or as a non-syndromic form. Non-syndromic hypodontia is more common, with different numbers of teeth that can be involved [7]. The unified aetiological explanation for anomalies of tooth number and size suggests these dental anomalies are caused by a complex interaction between genetic, epigenetic and environmental factors during the dental development process [8]. The prominent role of genes in hypodontia was emphasized by many studies [9,10]. Various genes are involved in the occurrence of dental agenesis: MSX, PAX9, TGFA, AXIN2 and WNT10A [11,11,12,13,15]. Among these genes, PAX9 has the highest number of mutations [15] and seems to be closely related to permanent molars' absence [16,17]. PAX9 is expressed in neural crest-derived mesenchyme, which is involved in odontogenesis [18]. Condensation of mesenchyme must occur around the tooth bud epithelium [18,19]. PAX9 mutations are likely to manifest as agenesis of second molars or a combination of agenesis of second premolars and mandibular incisors. PAX9 mutations also influence the position and morphology of teeth in affected individuals. Thus, concomitant occurrence of canine transposition and tooth agenesis was noted frequently [20]. PAX9 also plays a critical role in fetal development and cancer growth. It is involved in cell proliferation, apoptotic resistance, and cell migration and has been shown to be a prognostic marker of oesophageal squamous cell carcinoma [21].

Congenital absence of permanent teeth can determine aesthetic, masticatory and occlusal perturbations which may require a high complexity multidisciplinary treatment.

Because SPM agenesis is very rare and there are few studies related to this subject in the literature, the aim of the present study was to describe five clinical cases of patients with missing SPM and to highlight the accompanying dental abnormalities.

CASE REPORTS

All patients sought treatment in the Department of Pediatric Dentistry, Carol Davila University of Medicine and Pharmacy of Bucharest for various oral conditions. They were of Caucasian origin and were in good health with no history of trauma, systemic conditions or genetic syndromes. These 5 cases are the only patients with hypodontia diagnosed with missing SPM in our clinic during the last 20 years (patients with oligodontia excluded).

Case # 1 (female, age 8 years 2 months) was referred for treatment of carious lesions on primary molars. Intraoral examination revealed mixed dentition with the absence of both upper first permanent molars and slight midline deviation. Panoramic radiograph showed missing lower right SPM and both upper SPM and delayed development of upper first permanent molars. Lower first permanent molars were in a more advanced stage of development as compared to the upper ones. A developing second molar was noticed in the left side of the mandible with about 2/3 crown calcification. There was no trace of developing third molars in any of the quadrants (fig. 1).

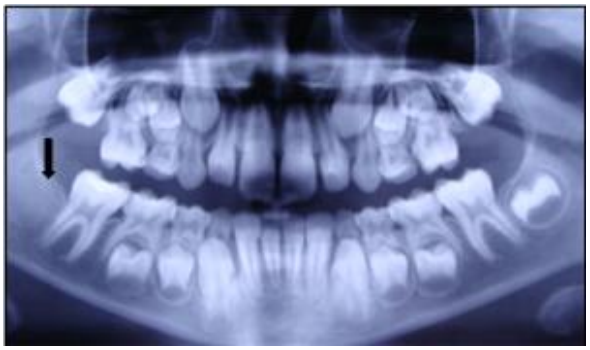

Figure 1. Panoramic radiograph of case 1.

Case report #2 (male, age 10 years 6 months) sought treatment for ectopic eruption

of both upper canines. Intraoral examination showed mixed dentition, a class I molar relationship with a centred dental midline and dental crowding. Radiological examination revealed congenital absence of lower left SPM and all third molars. Development of the three existing SPMs seemed delayed for the child's age, with almost completely calcified crowns and roots formation not started. In the quadrant with the missing SPM (lower left), the stage of development of the second premolar was delayed as compared to the other second premolars. Development of all the other teeth - except for the above-mentioned SPMs and lower left second premolar – was in accordance with the chronological age of the patient (fig. 2).

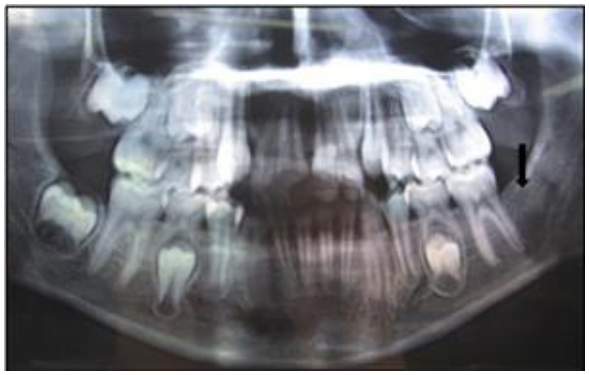

Figure 2. Panoramic radiograph of case 2.

Case #3 (female, age 11 years 2 months) was referred for the extraction of an overretained right upper first primary molar following the eruption of its successor (1.4). The patient had mixed dentition, with multiple untreated caries. Intraoral examination also revealed a class I molar relationship, an increased anterior overbite, midline deviation and dental crowding. Radiological examination revealed the absence of both lower SPMs, all third molars and lower left second premolar. Root development of both upper SPMs was delayed, while the development of all the other teeth was in accordance with the patient's chronological age (fig. 3).

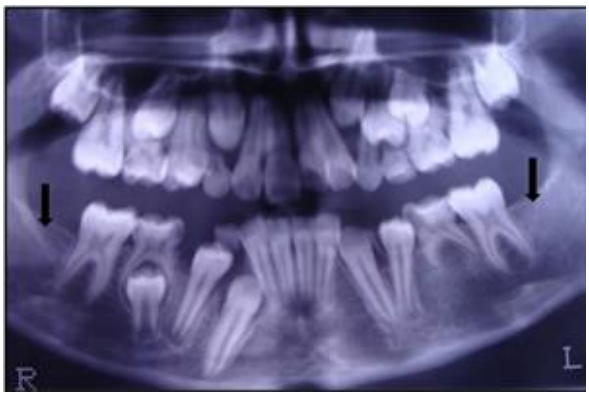

Figure 3. Panoramic radiograph of case 3.

Case report #4 (female, age 13 years 3 months) showed up in our department with a chief complaint of ectopic eruption of both upper canines. Clinical examination revealed late mixed dentition, with none of the SPMs erupted. A class II molar relationship, with a centered dental midline and an increased anterior overbite were also noted. Radiological examination exposed congenital absence of lower left SPM and both mandibular third molars. Important developmental delays were noted for the existing SPMs: one third of the roots of the upper SPMs were formed while crown mineralization of the right mandibular SPM was still incomplete. All of the other teeth, except the SPMs, were developed in accordance with the patient's chronological age (fig. 4).

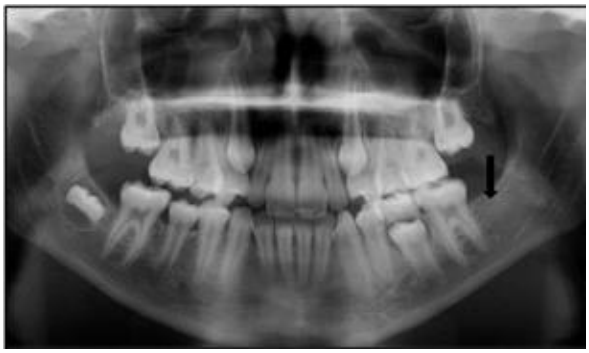

Figure 4. Panoramic radiograph of case 4.

Case report #5 (male, 17 years) was referred for conservative treatment of caries on lower left first permanent molar. Intraoral examination revealed absence of both lower

SPMs and overeruption of both maxillary SPMs, causing occlusal interference. Dental history confirmed that the patient did not undergo any extractions. Panoramic X-ray revealed agenesis of both lower SPM and both lower third molars (fig. 5).

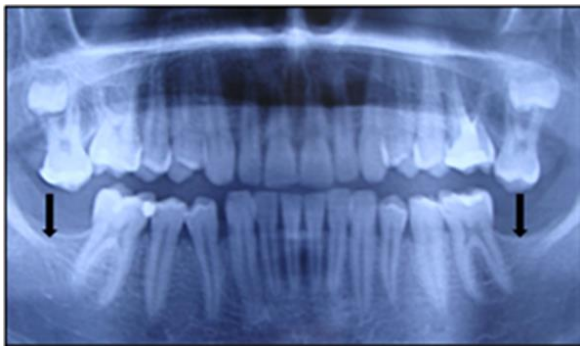

Figure 5. Panoramic radiograph of case 5.

Table 1 presents the correspondence between the chronological age and dental age of each patient. Dental age was calculated using Demirjian's method [21] while formula of Nystrom et al. was applied for patients with bilateral missing lower SPM [22].

In all cases, the patients underwent caries treatment and were referred to the orthodontist for examination and treatment.

Table 1. Chronological and dental age of reported cases.

Case no.	Gender	Missing SPM	Chronological age (years)	Dental age (years)
1	female	1.7, 2.7, 4.7	8.16	8.1
2	male	3.7	10.5	11
3	female	3.7, 4.7	11.16	9.6
4	female	3.7	13.25	10
5	male	3.7, 4.7	17	>16

RESULTS AND DISCUSSIONS

Accurate diagnosis of hypodontia requires radiographic, clinical and dental cast examinations to distinguish whether the tooth is extracted, impacted or congenitally absent. Agenesis of a permanent tooth has to be also differentiated from the delayed eruption of the tooth due to delayed development. Congenital absence of SPM is an extremely rare condition, which may appear as part of a syndrome or as a non-syndromic form. Research conducted on a sample of 1453 patients aged between 10 and 16 years from Sweden found a prevalence of agenesis of SPM of 0.8% (n=12 patients) having 23 missing SPM (15 of them were mandibular) [23]. No significant differences between sides (p=.763) or jaws (p=.132) were found. Aktan et al. [24] found 34 cases of SPM agenesis in a Turkish population of 10,057 (0.6%), whereas Cantekin et al. [25] did not detect any cases among 1291 patients. Goya et al. (2008) conducted a survey on 202 patients with agenesis in permanent teeth and reported only one case of congenitally missing SPM (0.5%) – a lower one, in a girl [26].

In Romania, research conducted by Zegan et al. on a sample of 111 patients with hypodontia in permanent teeth (n=178 missing teeth) reported 5 missing SPM, all in the mandible [27]. This finding is consistent with the results of another Romanian study [28] which found only mandibular congenitally missing SPMs in an orthodontic sample. Kerekes-Mathe et al. found only one congenitally missing lower SPM in 947 patients with a total number of 136 missing teeth [29].

A meta-analysis of 24 studies on agenesis in permanent teeth showed that from 11422 missing permanent teeth, 0.6% (n=67) were upper SPMs and 1.2% (n=141) were lower SPMs [29]. However, another meta-analysis by Khalaf et al. [3] demonstrated a more

balanced ratio (1.2/1) of the prevalence of mandibular and maxillary second molar agene-sis respectively.

Our five cases were 2 males and 3 females. Literature reviews de-scribed a higher prevalence of congenitally missing teeth in females [3,28]. On the other hand, Bondemark & Tsiopa (2007) found four girls and eight boys with agenesis of one or more SPM among 1543 Swedish patients, with no significant differences between genders (p=.404) [23].

Our five patients had a total of nine missing SPM: two patients had only one missing SPM, two patients had two missing SPMs each and one patient had 3 missing SPMs. Bondemark & Tsiopa noticed that in twelve patients with SPM agenesis, six patients had agenesis of one tooth, three of two teeth, and three patients of three or four SPMs [23]. Polder et al. reported that single second molar agenesis is more prevalent than multiple second molar agenesis and mostly occurs with other types of dental anomalies such as congenital absence of other teeth, microdontia or delayed tooth formation [30].

In four of the clinical cases presented above only lower SPM were missing and in all these cases there was an association with the agenesis of the neighboring third molar. In one of these cases, the agenesis of SPM was also associated with a missing lower second premolar.

Only one case (Case # 1, female, age 8 years 2 months) had both upper and lower missing SPMs. In this case, delayed eruption of upper first permanent molars was noticed. Rasmussen [31] named the first permanent molar showing delayed eruption as the "9-year-molar", because the first permanent molar often erupted at approximately 9 years of age. Lee et al. (2017) conducted a study on a sample of 40 subjects with delayed eruption and development of the first permanent molars (n=69 teeth) and they found 30 missing SPMs and 39 delayed SPMs in the same quadrant as the delayed first permanent molar [32]. This indicates that delayed first permanent molar may be a result of defects in genetic or signal transduction processes involved in tooth development of the affected field, rather than single defects of the first molar [32]. Several studies confirmed that the incidence of delayed first permanent molars is higher in the maxilla as compared to the mandible, and is more frequently found in female than in male patients [31,32,33].

Another important finding in our series of cases was that patients with agenesis of SPMs showed significantly disturbed development of their other SPMs. In four cases, there was a delayed development of the existing SPMs noticed on the panoramic radiograph. This finding is consistent with the report of Bondemark & Tsiopa [23]. Congenital absence of SPM is determined by a number of complex interactions between genetic, epigenetic and environmental factors that intervene during the process of dental development and more teeth can be affected at the same time. When available, 3D imaging may give more detailed information on each affected tooth's development.

Even though SPM agenesis does not occur frequently, early diagnosis is very important in order to initiate treatment at the optimal time. Absence of these teeth is associated in many cases with agenesia of third molars, which leads to impaired masticatory function by reducing the number of dental units. In addition, if a single SPM is missing or only the lower SPMs are absent or the agenesis is diagonal and diagnosis is not made in time, dysfunctional occlusion may occur through the migration of opposing teeth, as seen in case #5.

Treatment of congenitally missing teeth is comprehensive. A number of factors should be taken into account for treatment planning: distribution of missing teeth, occlusion, facial

growth pattern, patient's preferences. Congenitally missing teeth may represent an interdisciplinary challenge for specialists in oral and maxillofacial surgery, operative dentistry, pediatric dentistry, orthodontics and prosthodontics [34,35].

CONCLUSIONS

Patients with agenesis of SPM showed a significantly disturbed development of their other SPMs. Congenitally missing SPMs can be associated with agenesis of neighboring third molar. Altered (delayed) development of other teeth (e.g., first permanent molars) can also be associated, with consequences upon the dental age of the child patient. Even though SPMs agenesis does not occur frequently, early diagnosis is very important in order to prevent the impairment of masticatory function and occlusal dysfunctions.

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