A Retrospective Study of Association between Peg-shaped Maxillary Lateral Incisors and Dental Anomalies

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***Objective**: The purpose of this study was to investigate the prevalence of peg-shaped maxillary lateral incisors and the incidence of associated dental anomalies in children. **Study design**: We investigated the prevalence of peg-laterals and incidence of associated dental anomalies in 3,834 children aged 7–15 who visited the Department of Pediatric Dentistry from January 2010 to December 2015 and underwent panoramic radiographs. **Results**: The prevalence of peg-laterals was 1.69% in boys, 1.75% in girls, and 1.72% overall. Among children with peg-laterals, the frequencies of associated dental anomalies were as follows: congenitally missing teeth, 31.8%; dens invaginatus, 19.7%; palatally displaced canines, 12.1%; supernumerary teeth, 7.6%; and transposition, 7.6%. **Conclusion**: As children with peg-laterals have a higher incidence of other dental anomalies, careful consideration is needed when planning diagnosis and treatment.*

Keywords: dental anomalies, prevalence, peg-shaped maxillary lateral incisors

INTRODUCTION

Tooth agenesis is the most common tooth abnormality, and is known to be associated with mutations of the *MSX1*, *PAX9*, and *AXIN2* genes[1-4]. Tooth agenesis may occur at each stage of tooth development, including initiation, proliferation, histodifferentiation, morphodifferentiation, apposition, and calcification, and may also occur at the time of root development and eruption[2,5,6]. Tooth agenesis may lead to esthetic and functional problems in the oral cavity; thus, its early detection and treatment are critical[7]. Tooth agenesis is often associated with other tooth abnormalities such as microdontia, ectopic eruption, and delayed dental development; these conditions commonly occur concurrently[8-15], probably due to a variety of phenotypic expressions of the same genetic code[8].

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Maxillary lateral incisors excluding the third molars have the most morphological variations[16], while maxillary canines have the greatest frequency of impaction[17]. According to Grahnen[18], a peg-shaped tooth is defined as a tooth in which the incisal mesiodistal width of the crown is smaller than the cervical width; this condition usually appears in maxillary lateral incisors, which are then called peg-laterals. Because peg-laterals may cause esthetic and orthodontic problems, they can be a major concern among dentists.

The reported prevalence of peg-laterals ranges from 0.6% to 9.9%, varying by ethnicity, sex, and region, but the overall prevalence is about 1.8%, which corresponds to one in 55 people worldwide[18]. Peg-laterals are also known to be associated with the palatal displacement of maxillary canines and other dental anomalies, requiring careful oral examinations by dentists[8-11].

In this study, we investigated the prevalence of peg-laterals among children from 7–15 years of age, and compared the incidence of dental anomalies in patients with peg-laterals vs the general population.

MATERIALS AND METHOD

The subjects of this study were 3,834 children from 7–15 years of age (1,894 male, 1,940 female) who visited the Department of Pediatric Dentistry at Chonnam National University Dental Hospital from January 2010 to December 2015 and underwent panoramic radiographs. The age of study subjects was based on the consideration that the enamel of the permanent second molars—the hard tissue that is formed last, aside from the third molars—is thought to be completely formed by about 7 years of age. The mesiodistal width of the maxillary lateral incisors is typically about 70%–80%

that of the maxillary central incisors, or 1.5–2 mm smaller. In this study, the diagnosis criterion for a peg-lateral was a maxillary lateral incisor with an incisal mesiodistal width smaller than its cervical width on panoramic radiograph, as defined by Grahnen[18]. To determine the association between peg-laterals and other dental anomalies, we also investigated the incidence of congenitally missing teeth (excluding the third molars), palatally displaced canines, supernumerary teeth, and dens invaginatus among patients with peg-laterals through panoramic radiograph, and compared these with the prevalence in the general population. Palatally displaced canines were diagnosed by dental cone beam computed tomography in addition to panoramic radiograph.

Statistical analysis

One calibrated investigator examined the panoramic radiographs and diagnosed the dental anomalies. The chi-square test was used to compare the results of this study with previously known reference values for the frequency of dental anomalies[12,19-22]. The hypothesis was tested at the 5% level of significance. The odds ratio **(OR)** was calculated at the 95% confidence interval **(CI)** to measure the strength of associations between peg-shaped maxillary lateral incisors and the other dental anomalies investigated.

RESULTS

Of 3,834 total patients (1,894 male, 1,940 female), 66 (1.7%) had peg-laterals, including 32 boys (48.5%) and 34 girls (51.5%) (Table 1). Among those, there were 35 patients (53.0%) with bilateral peg-laterals and 31 (47.0%) with unilateral peg-laterals (Table 2).

The prevalence of other dental anomalies among the 66 children with peg-laterals is shown in Table 3. Patients with peg-laterals were found to have significantly higher incidences of congenitally missing teeth, dens invaginatus, palatally displaced canines, supernumerary teeth, and tooth transposition than those in the general population. Congenitally missing teeth (excluding the third molars) were observed in 31.8% of children with peg-laterals, which was significantly higher than the reference value for the general population (OR 6.8). In particular, 6 (19.4%) out of 31 children with unilateral peg-laterals had a missing contralateral maxillary lateral incisor. Dens invaginatus was found in 19.7% of patients with peg-laterals, which was more than three times higher than the reference value (OR 3.4); all dens invaginatus were present in maxillary lateral incisors. Palatally displaced canines and tooth transposition were also found to be significantly higher: 12.1% (OR 9.0) and 7.6% (OR 21.3), respectively.

Table 1. Prevalence of peg-laterals according to sex

	Male		Female		Total	
	(n = 1,894)	%	(n = 1,940)	%	(n = 3,834)	%
Peg-laterals	32	1.7	34	1.8	66	1.7

Table 2. Distribution of peg-laterals according to location and sex

Location	Male	Female	Total (%)
Right side	2	9	11 (16.7%)
Left side	10	10	20 (30.3%)
Bilateral	20	15	35 (53.0%)
Total (%)	32 (48.5%)	34 (51.5%)	

DISCUSSION

This study aimed to investigate the prevalence of peg-laterals and the incidence of associated dental anomalies among children. Children with peg-laterals exhibited higher incidences of congenitally missing teeth, dens invaginatus, palatally displaced canines, supernumerary teeth, and tooth transposition compared with known reference values.

The most common tooth abnormality is tooth-size change, which is most frequently observed in maxillary lateral incisors (excluding the third molars); peg-laterals are the most common of such abnormalities[18]. Tooth size is determined genetically, and it has been reported that macrodontia is more prevalent in men whereas microdontia is more prevalent in women[23]. The present study also found that peg-laterals had a slightly higher prevalence in girls (51.5%). Although the prevalence of peg-laterals has been reported to vary from 0.6%–9.9% depending on ethnicity, sex, and region, the overall prevalence is about 1.8%[18], which is similar to the 1.7% found in this study. In addition, unilateral or bilateral peg-laterals are known to appear at a similar rate[24]. The proportion of unilateral and bilateral peg-laterals in this study was similar, at 47.0% and 53.0%, respectively.

Patients with unilateral peg-laterals have shown a high frequency of missing contralateral maxillary lateral incisors[10,25]. In this study, 6 (19.4%) out of 31 children with unilateral peg-laterals also had missing contralateral maxillary lateral incisors, a prevalence higher than that among all patients with peg-laterals. Although the exact cause is unknown, peg-laterals are reported to occur about 2 times more frequently on the left side than on the right[18]. In contrast, peg-laterals were found to occur 1.82 times more frequently on the right side than on the left in this study. Furthermore, there is a close association between the crown width of lateral incisors and the root length[26]. Peg-laterals tend to have shorter root lengths than normal lateral incisors; therefore, reduction in the mesiodistal width of peg-laterals reflects a reduction in root length.

Congenitally missing teeth is a condition defined as a smaller-than-normal number of teeth due to abnormalities occurring during tooth development, with the maxillary lateral incisors being the most commonly missing teeth (excluding the third molars)[10]. The reported prevalence of congenitally missing teeth ranges from 0.15%–16.2%[27]. In the present study, the prevalence of congenitally missing teeth in patients with peg-laterals was high at 31.8%, showing a strong association. It has been reported that congenitally missing teeth may be related to microdontia, taurodontism, tooth transposition, supernumerary teeth, ectopic eruption, and prolonged retention of the deciduous teeth[10,12]. In particular, the incidence of skeletal class III malocclusion, palatally displaced canines, and contralateral peg-laterals is known to be significantly increased in patients with a missing maxillary lateral incisor[10,11]. In addition, while an association between congenitally missing teeth and tooth size reduction has been suggested, it has been reported that developmental absence of teeth may be genetically related to overall tooth size[24].

Table 3. Prevalence rate of dental anomalies in subjects with peg-shaped maxillary lateral incisors compared with reference values

Dental anomaly	Prevalence rate in this study	Reference value	Study	Chi-square	OR	95% CI
Congenitally missing teeth	31.8% (22/66)	6.9% (75/1,093)	Davis,[19] 1987	56.873 $P < 0.001$	6.79	(3.865–11.916)
Dens invaginatus	19.7% (13/66)	6.8% (50/739)	Backman & Wahlin,[20] 2001	14.045 $P < 0.001$	3.38	(1.728–6.613)
Palatally displaced canines	12.1% (9/66)	1.7% (25/1,450)	Dachi & Howell,[21] 1961	40.857 $P < 0.001$	9.00	(4.017–20.162)
Supernumerary teeth	7.6% (5/66)	3.9% (39/1,000)	Baccetti,[12] 1998	2.114 $P = 0.146$	2.02	(0.768–5.308)
Transposition	7.6% (5/66)	0.38% (21/5,486)	Yilmaz et al.,[22] 2005	72.390 $P < 0.001$	21.33	(7.789–58.416)

CI, confidence interval; OR, odds ratio.

Dens invaginatus is currently the most widely used name for the condition originally introduced as "tooth within tooth"[28]. It occurs mostly in the maxillary lateral incisors, but also in the maxillary central incisors, the second molars, and other teeth. Globally, an incidence of 0.3%–10% has been reported[28]. In the present study, the incidence of dens invaginatus in patients with peg-laterals was high at 19.7%, with an unusual finding of dens invaginatus occurring only in peg-laterals.

The maxillary canines are the most commonly impacted permanent teeth, excluding the third molars[17]. Displacement of maxillary canines is defined as the state in which maxillary canines show bone displacement before physiological eruption[9]. In the European population, 70%–85% of maxillary canine displacements are palatal, with an overall prevalence of 0.8%–2.8%[17], whereas in the Asian population, only about 30% of maxillary canine displacements are palatal[29]. In this study, the incidence of palatally displaced canines in patients with peg-laterals was relatively high at 12.1%. Causes of palatally displaced canines include lateness in the eruption sequence, long eruption path, dental crowding, delayed root resorption of primary canines, transverse maxillary deficiency, and missing maxillary lateral incisor[7,11,24,26,29]. In addition, the absence of second premolars and third molars, presence of peg-laterals, and infraocclusion of primary molars are often associated with palatally displaced canines[8,17,30]. Currently, palatally displaced canines are explained by two theories: the first suggests that they are caused by local factors such as missing maxillary lateral incisors or agenesis; the second suggests a genetic etiology based on studies of family history, sex, and population[8,11,12]. Patients with palatally displaced canines are known to have a high incidence of class II division 2 malocclusion[11], with smaller mesiodistal width of anterior teeth. According to the results of orthodontic diagnosis, non-extraction treatment is predominant in these patients[17,29,31]. In addition, as the length of the maxillary lateral incisors is reduced, the maxillary canines tend to lean toward the palate and a small tooth tends to develop later, thereby requiring careful observation of displaced canines with regard to peg-laterals[9,24,26].

The causes of supernumerary teeth (those additional to the normal dentition) have not yet been elucidated, but these abnormalities occur commonly in the upper maxilla and can occur in all other regions of the dental arch[32]. The prevalence of this condition varies from 0.3%–0.8% in the deciduous dentition and 1.5%–3.5% in the permanent dentition, and the majority (80%) of supernumerary teeth are mesiodens[7,32,33]. In addition, this condition is known to occur more frequently in men than in women[33]. In this study, the incidence of supernumerary teeth in patients with peg-laterals was found to be 7.6%, which is higher than the commonly known prevalence.

Tooth transposition is defined as the positional interchange of two neighboring teeth, or the abnormal eruption of a non-neighboring normal tooth[13]. The majority of tooth transpositions take place between maxillary canines and first premolars or between maxillary lateral incisors and maxillary canines, with an average prevalence of 0.33%[34,35]. In the present study, tooth transpositions were found only between maxillary canines and first premolars or between maxillary lateral incisors and canines, and the overall incidence was relatively high at 7.6%.

This study aimed to investigate the prevalence of peg-laterals, which are occasionally encountered in dental clinical practice, and to examine the incidence of associated dental anomalies in patients with peg-laterals. Patients with peg-laterals often have esthetic complaints, and often are in need of orthodontic treatment or prosthetic restoration. In this event, it is very important to plan treatment by thoroughly examining patients for any dental anomalies associated with peg-laterals. The results of this study will be useful for investigating other dental anomalies associated with peg-laterals, and will help in proper diagnosis and treatment planning.

CONCLUSION

In this study, we investigated the prevalence of peg-laterals and associated dental anomalies in children from 7–15 years of age. The prevalence of peg-laterals was 1.7%, accounting for 48.5% of boys and 51.5% of girls. Dental anomalies with a high incidence in patients with peg-laterals included congenitally missing teeth (31.8%), dens invaginatus (19.7%), palatally displaced canines (12.1%), supernumerary teeth (7.6%), and tooth transposition (7.6%). Therefore, when encountering a patient with peg-laterals in clinical practice, careful observation and attention to other possible dental anomalies are required for reasonable diagnosis and treatment planning.

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