ORIGINAL ARTICLE

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Prevalence of pre-eruptive intracoronal resorptions in children and evaluation of associated factors: A retrospective study

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Purpose: This study aimed to determine the prevalence of pre-eruptive intracoronal resorption (PEIR) in children aged 4–14, evaluate the most commonly affected teeth, and identify possible etiological factors.

Methods: In this retrospective study, panoramic radiographs of pediatric patients who applied to the Department of Pediatric Dentistry at Bolu Abant İzzet Baysal University were examined between 2020 and 2023. Radiographs with sufficient diagnostic image quality and at least one unerupted permanent tooth were included in the study. The presence of PEIR, the lesion's localization, depth, the number of affected teeth, and possible etiological factors were examined.

Results: 2229 panoramic radiographs were examined. 1893 of them were found to meet the study criteria. PEIR was detected in 64 patients, and the number of teeth with PEIR was 88. PEIR was seen at a rate of 3.4% on an individual basis and 0.34% on a tooth basis. It was most frequently detected in mandibular second molars and at Grade 1 level. Lesions were more commonly located in the mandible and on the right side; in most individuals, only one tooth was affected. No significant predisposing factor was found in 90.9% of the cases.

Conclusion: PEIR is a lesion that should be carefully monitored in the early age group and progresses asymptomatically most of the time. Early diagnosis and regular radiographic follow-up are essential to prevent pulpal complications.

Keywords: Intracoronal; unerupted teeth; resorption; etiology.

Introduction

Pre-eruptive intracoronal resorptions (PEIR) are caries-like lesions in unerupted teeth, usually located in the dentin, adjacent to the enamel dentin junction (1,2). Unlike caries, these teeth are not fully erupted and have no connection with the oral flora. This lesion is usually asymptomatic and is diagnosed on routine radiographic examination (3,4). Although often located in the central or mesial part of the crown, the depth of the lesion does not usually involve the pulp (5). Various etiologies of pre-eruptive intracoronal resorption have been identified, including deciduous periapical lesions, systemic factors, and it is now generally accepted that PEIR is a resorption process (6–8). A strong association with PEIR has also been reported in individuals with significantly delayed dentition development (9).

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Histopathologic examination of PEIR lesions revealed the presence of multinucleated giant cells, osteoclasts, and chronic inflammatory cells representing resorption. Although the factors that trigger this process are not completely clear, it has been suggested that factors that may create abnormal local pressure, such as ectopic location of the tooth germ and cystic lesions around the tooth, may cause this condition (5,10).

The most important clinical risk of PEIR is the rapid progression of the lesion, threatening the pulp tissue and necessitating endodontic treatment. The retentive nature of the lesion promotes caries development and becomes indistinguishable from caries lesions once in the oral environment (11). Studies show that PEIR causes the majority of cases diagnosed as occult caries, and that if these lesions are not detected early, they can lead to complications such as abscesses, advanced tooth structure loss, and ultimately the need for endodontic treatment (6).

There are different approaches to treating PEIR depending on the lesion size. Factors such as lesion depth, condition of pulpal and periapical tissues, whether the tooth is symptomatic or not, and patient cooperation should be considered in treatment planning (8). When the case reports in the literature are examined, it is stated that small lesions are usually followed, and in medium or large lesions, it is more appropriate to expose, clean and restore the unerupted tooth surgically to limit the lesion, prevent its progression to the dental pulp and protect it from possible pulpal penetration (5,12,13). Therefore, early diagnosis of PEIR is essential in treating it with minimally invasive approaches and preventing more serious complications (14–18). This study aims to determine the incidence of PEIR, the most commonly affected teeth, and the etiologic factors that may cause this condition in the pediatric patient population aged 4-14 years after radiographic analysis.

Materials and Methods

This study was approved by the local ethics committee of Bolu Abant Izzet Baysal University, Bolu, Türkiye (Decision no: 2024/168). The research adhered to the Strengthening of Reporting of Observational Studies in Epidemiology (STROBE) checklist for cross-sectional investigations. The study was conducted under the principles of the Declaration of Helsinki.

Data Collection

In this retrospective study, patients aged 4-14 who applied to Bolu Abant İzzet Baysal University, Department of Pediatric Dentistry, between 2020-2023 and who had taken panoramic radiography for any reason were included. A total of 2229 panoramic radiographs taken on the specified dates were analyzed. The panoramic radiographs included in the study had to be diagnostically adequate and contain at least one unerupted permanent tooth. Radiographs with poor quality images and radiographs of individuals with dental pathologies such as amelogenesis imperfecta, dentinogenesis imperfecta, and bone pathologies were excluded.

Data Analysis

In all patients, age, gender, number of unerupted teeth, number of teeth with PEIR defects, number of teeth/teeth with PEIR, localization of the defect on the tooth crown (mesial, central, distal), and the extent of the lesion were evaluated. In addition, the presence of ectopic location, supernumerary tooth or cyst, caries, infection, restorative treatment, or extraction in the deciduous tooth overlying the unerupted tooth was also recorded. The prevalence of PEIR lesions was determined according to the subject and the teeth. The severity of the lesion was graded according to the mesiodistal dimension of the dentin in the tooth crown, using Seow's classification. First-grade lesions cover less than 1/3 of the available dentin thickness. Second-grade lesions extend over 1/3 and 2/3 of the available dentin thickness. Third-grade lesions involve more than 2/3 of the available dentin thickness.

Two pediatric dentists performed radiographic examinations. Before starting the evaluations, both assessors were calibrated by examining PEIR on 20 pre-selected panoramic radiographs. The Intraclass Correlation Coefficient (ICC) was calculated for inter-rater and intra-rater reliability analyses by re-examining the same radiographs 15 days apart. ICC values were over 80%. This shows that the raters gave consistent and reliable results both within themselves and with each other in diagnosing PEIR.

Statistical Analysis

Data were analyzed using the IBM SPSS V23 file. Binary logistic regression analysis was used to program unadjusted and adjusted odds ratios (OR) with 95% confidence intervals (CI) for the performance values of independent variables above the presence of PEIR. Fisher's Exact Test with Monte Carlo input is examined for the range between categorical data. Mean ± standard deviation and median (minimum-maximum) represent quantitative data. Frequency and percentage were used to represent categorical data. Significance level was included as $p < 0.05$.

Results

Panoramic radiographs of 2229 patients were examined

within the scope of the study, and 1893 of them that met the study criteria were evaluated. The total number of teeth that were unerupted by the assessed individuals was determined to be 25810, and the total number of teeth with PEIR was determined to be 88. Lesions were observed in a total of 64 patients. The median age of the individuals participating in the study was calculated as 9. When the distribution by age groups was examined, it was determined that 8% of the participants were under the age of 6, 77.6% were between the ages of 6-12, and 14.4% were 12 years of age and over. In the gender distribution, the rate of women was 52.1% and the rate of men was 47.9%.

When systemic disease status was evaluated, it was seen that most participants (89%) did not have any systemic disease. Among the existing diseases, epilepsy (4.7%) was the most common condition. In contrast, diseases such as autism spectrum disorder (ASD), familial Mediterranean fever (FMF), operated congenital cleft palate (CCP), and anemia were detected at lower rates (1.6%). The study detected PEIR in at least one tooth in 3.4% of the participating individuals. Among these individuals, 45 had one affected tooth, 16 had two affected teeth, one had three, and two had four affected teeth. PEIR was detected in 0.34% of unerupted teeth (Table 1).

According to tooth-based descriptive statistics (Table 2), the incidence of PEIR in the mandible (65.9%) was found to be higher than in the maxilla (34.1%) (Fig. 1). It was observed that PEIR cases were mostly on the right side (54.5%). The most common localization in the tooth was in the central region (76.1%) (Fig. 2), followed by the mesial (14.8%) and distal (9.1%) regions.

When the thickness of the tooth involvement was examined, it was seen that the majority of the cases had an involvement of less than 1/3 of the dentin thickness (84.1%) (Fig. 3). Deeper involvement rates were determined as 12.5% in the range of 1/3 - 2/3 and 3.4% in those with more than 2/3, respectively.

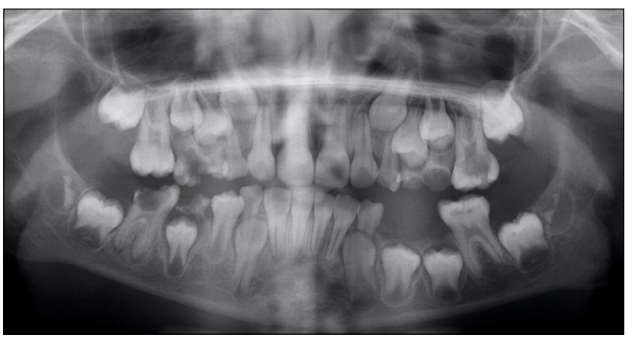

Fig. 1. Grade 1 PEIR lesions in tooth numbers 47-37.

Table 1. Patient-based descriptive statistics

	Mean ± s. deviation / Frequency	Median (min-max) / Percentage
Age	9.329 ± 2.619	9 (4 - 14)
Age group		
< 6 years	151	8
6–12 years	1469	77.6
> 12 years	273	14.4
Gender		
Female	986	52.1
Male	907	47.9
Systemic disease		
No	57	89
Epilepsy	3	4.7
ASD	1	1.6
FMF	1	1.6
Opere DDI	1	1.6
Anemia	1	1.6
Number of teeth with PEIR detected		
0	1829	96.6
1	45	2.4
2	16	0.8
3	1	0.1
4	2	0.1

Mean ± standard deviation, Median (minimum-maximum), n (%).

Table 2. Tooth-based descriptive statistics

	Mean ± s. deviation / Frequency	Median (min-max) / Percentage
Dental Arch		
Maxilla	30	34.1
Mandible	58	65.9
Arch Side		
Right	48	54.5
Left	40	45.5
Location		
Mesial	13	14.8
Central	67	76.1
Distal	8	9.1
Lesion Grade		
Grade 1	74	84.1
Grade 2	11	12.5
Grade 3	3	3.4
Etiologic factor		
No	80	90.9
Ectopic location	1	1.1
Decayed	1	1.1
Periapical lesion	2	2.3
Extracted	3	3.4
Endodontically treated	1	1.1

Mean ± standard deviation, Median (minimum-maximum), n (%).

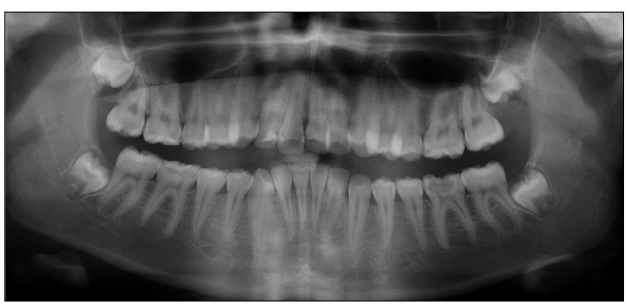

Fig. 2. Grade 2 PEIR lesion in tooth number 48.

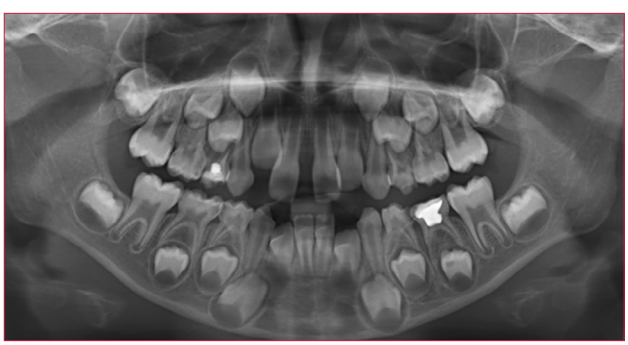

Fig. 3. Grade 1 PEIR lesion in tooth number 35.

When the etiological factors that may cause PEIR were evaluated, no predisposing factor was detected in most cases (90.9%). The most common cause among the possible factors was the extraction of the overlying primary tooth (3.4%). Other factors such as ectopic location, caries in the overlying primary tooth, periapical lesion, or endodontic treatment were observed at low rates (1.1% and 2.3%).

Table 3. Descriptive statistics of the detected tooth numbers

Tooth Number	Frequency	Percentage
13	3	3.4
14	2	2.3
16	4	4.5
17	8	9.1
21	1	1.1
23	1	1.1
26	4	4.5
27	6	6.8
35	2	2.3
36	9	10.2
37	16	18.2
43	1	1.1
45	2	2.3
46	15	17
47	13	14.8
48	1	1.1

n(%).

Descriptive statistics of the tooth numbers with PEIR are presented in Table 3. PEIR lesions were most frequently detected in mandibular molars.

Table 4. Binary logistic regression results for PEIR risk (patient-level analysis)

	PEIR risk		Univariate		Multiple	
	No	Yes	OR (95% CI)	p	OR (95% CI)	p
Age	9.363 ± 2.611	8.3v64 ± 2.67	0.868 (0.786 – 0.957)	0.005	0.835 (0.713 – 0.978)	0.026
Age group						
< 6 years	141 (93.3)	10 (6.7)	2.695 (1.004 – 7.233)	0.049	0.574 (0.107 – 3.072)	0.516
6–12 years	1422 (96.8)	47 (3.2)	1.256 (0.562 – 2.809)	0.579	0.544 (0.179 – 1.655)	0.283
> 12 years	266 (97.4)	7 (2.6)				
Gender						
Female	955 (96.9)	31 (3.1)	0.860 (0.522 – 1.416)	0.553	0.835 (0.506 – 1.378)	0.481
Male	874 (96.3)	33 (3.7)				

OR (95% CI): Odds ratio (95% confidence interval).

Table 5. Distribution of PEIR-positive teeth according to age groups and categorical characteristics

	Age Group					
	< 6 years	6–12 years	> 12 years	Total	Test statistic	p
Dental Arch						
Maxilla	5 (31.3)	25 (39.1)	0 (0)	30 (34.1)	5.046	0.071*
Mandible	11 (68.8)	39 (60.9)	8 (100)	58 (65.9)		
Arch Side						
Right	8 (50)	34 (53.1)	6 (75)	48 (54.5)	1.471	0.505*
Left	8 (50)	30 (46.9)	2 (25)	40 (45.5)		
Location						
Mesial	1 (6.3)	10 (15.6)	2 (25)	13 (14.8)	2.458	0.637*
Central	14 (87.5)	48 (75)	5 (62.5)	67 (76.1)		
Distal	1 (6.3)	6 (9.4)	1 (12.5)	8 (9.1)		
Lesion Grade						
Grade 1	13 (81.3)	55 (85.9)	6 (75)	74 (84.1)	4.063	0.349*
Grade 2	2 (12.5)	8 (12.5)	1 (12.5)	11 (12.5)		
Grade 3	1 (6.3)	1 (1.6)	1 (12.5)	3 (3.4)		
Etiologic factor						
No	15 (93.8)	59 (92.2)	6 (75)	80 (90.9)	14.254	0.161*
Ectopic location	0 (0)	1 (1.6)	0 (0)	1 (1.1)		
Decayed	1 (6.3)	0 (0)	0 (0)	1 (1.1)		
Periapical lesion	0 (0)	2 (3.1)	0 (0)	2 (2.3)		
Extracted	0 (0)	1 (1.6)	2 (25)	3 (3.4)		
Endodontically treated	0 (0)	1 (1.6)	0 (0)	1 (1.1)		

*Fisher's Exact Test with Monte Carlo Correction; n(%).

The effect of independent variables on PEIR risk was evaluated using binary logistic regression analysis and univariate and multiple models (Table 4). In the evaluation, the presence of PEIR was considered at the individual level, and the analyses were performed according to whether the patient had at least one affected tooth.

According to the univariate model results, each unit decrease in age increases the risk of PEIR (1/0,868) by 1,152 times ($p = 0.005$). In addition, the risk of PEIR in individuals aged 12 and over was calculated as 2,695 times higher than in individuals under 6 years of age. However, other independent variables did not have a statistically significant effect on the risk of PEIR ($p > 0.05$).

A similar trend was observed in the multiple model analysis, and it was determined that each unit decrease in age increased the risk of PEIR (1/0,835) by 1.197 times ($p = 0.026$). However, no significant effect of other independent variables on the risk of PEIR was detected ($p > 0.05$).

The data presented in Table 5 examined the relationship between age groups and Peir's dental arch localization, arch direction, localization on the tooth, involvement thickness, and etiological factors. In the analyses, no statistically significant difference was found between age groups regarding all variables ($p > 0.05$).

When etiological factors were evaluated, no predisposing factor was found in most cases of PEIR in all age groups (75%- 93.8%). The most frequently observed factors were extraction of the primary tooth or the presence of a periapical lesion in the primary tooth; no significant relationship was found between age and etiological factors ($p = 0.161$).

Discussion

PEIR is a vital anomaly associated with unerupted teeth. However, clinicians often overlook these defects during radiographic evaluation. The most important clinical risk of PEIR is that the lesion can progress rapidly, threaten the pulp tissue, and may lead to the need for endodontic treatment (19).

Studies emphasize that advanced PEIR lesions can reach the pulp tissue, which requires surgical intervention and restoration as soon as the lesion is detected radiographically (17).

Panoramic radiographs were preferred in this study to evaluate the prevalence of PEIR. Panoramic radiography is a routine diagnostic method widely used in dentistry practice and offers significant advantages, especially in pediatric patients, since it requires less collaboration than other imaging techniques. The ability to obtain a general view of all permanent and unerupted teeth with a single panoramic film is one of the main reasons this method is preferred in PEIR scans. In addition, panoramic radiography offers a wider anatomical field of view than conventional radiographs. It can be applied with lower radiation dose and equipment cost than cone beam computed tomography (CBCT), increasing the method's practicality. (3,7). Considering all these factors, panoramic radiographs were preferred in this study to evaluate the prevalence of PEIR.

When the literature was examined, the subject prevalence for PEIR was reported as 3.54% (0.56%–27.31%), and the dental prevalence was reported as 0.695% (0.073%–2.12%) (7). In this study, the subject PEIR prevalence was found to be 3.4%, and the dental prevalence was found to be 0.34%. In this sense, the findings largely overlap with the existing literature data. In another study, the subject prevalence was found to be 15.1% and the dental prevalence was found to be 3.5% (2). This difference is thought to be due to the imaging methods used. The study in question was conducted using CBCT, which is more sensitive in detecting small lesions due to its higher resolution and three-dimensional imaging advantage. However, the fact that CBCT cannot be used for every individual in routine clinical practice creates an essential limitation in terms of both cost and radiation dose (20).

The current study included the 4-14 age groups, and according to the findings, it was found that it was seen in 6.7% under 6 years of age, 3.2% in the 6-12 age group, and 2.6% over 12 years of age. It was determined that the prevalence of PEIR was higher in children under 6 years of age compared to other age groups. According to the current study's findings, each unit decrease in age is associated with an increase in the risk of PEIR. This may be due to the increased number of unerupted teeth in younger age groups, which increases the probability of early detection of lesions before they erupt into the oral environment. According to the study by Umansky et al. (1), no lesions were detected in the younger age group (4-8 years), while lesions were observed in 4.8% of individuals aged 9-12 and 3.7% aged 13 years and older. It was reported by Asokan et al., (3) that the prevalence of PEIR was found to be 3.9% in children under 6 years of age, 3.1% in the 6–9 age group, and 3.2% in the 10–14 age group, and no significant difference was found between age groups. In another study, the prevalence was reported as 4.93% in children under 6 years of age, 7.38% in the 6–12 age group, and 2.53% in those over 12 years of age (8). Although different results are found in the literature regarding the prevalence of PEIR depending on age, the present study's findings reveal that lesions can be seen in the early age group. This situation shows that careful radiographic follow-up is clinically significant, especially in the early age group.

The present study observed that PEIR cases were detected at a higher rate in the mandible than the maxilla. Similarly, studies on different populations reported a higher prevalence of PEIR in the mandible than in the maxilla (7,21,22). An important factor contributing to this situation may be the anatomical limitations of radiographic imaging techniques. In general, bitewing and panoramic radiographs are inadequate for clearly visualizing the crowns of unerupted maxillary premolars and molars. In contrast, these structures can be more clearly observed in mandibular teeth (2). Therefore, PEIR lesions in unerupted maxillary teeth may be missed diagnostically, especially in the mixed dentition. This may lead to underreporting the prevalence of PEIR in the maxillary region due to inadequate radiographic visualization of the involved teeth (23).

In the present study, PEIR lesions were most frequently seen in mandibular molars, especially mandibular sec-

ond molars, followed by maxillary molars, mandibular premolars, and mandibular canines, respectively. In line with the present study, Ozden and Açıkgoz (17) reported that PEIR lesions were most frequently seen in mandibular second molars. Again, in the study by Manmontri et al.(23), the teeth most commonly affected by PEIR are mandibular second molars.

In addition, it has been reported in different studies that the tooth groups in which PEIR is most frequently seen vary. One study reported that mandibular molars had the highest PEIR prevalence with 18.6%, supernumerary teeth with 17.6%, maxillary molars with 13.3%, and maxillary canines with 11.6% (10). A systematic review study reported that the most frequently affected teeth were mandibular first premolars, followed by mandibular second premolars; in the maxillary arch, canines and second molars were the most affected (7). It is thought that these differences may be due to differences in the average age of the individuals included in the studies, population diversity, ethnic and geographical factors, and radiological imaging methods used.

Studies in the literature report that PEIR lesions are most frequently seen in third molars (1,2,6,22). The fact that only one PEIR case was detected in the third molars in the current study may be related to the low average age of the study group and the fact that the developmental process of the relevant teeth has not yet been completed. Especially in young populations, since the third molars have not yet completed their development by 12, it becomes difficult to detect the presence of PEIR in these teeth (1).

The most common PEIR score in the current study is Grade 1, and this finding is consistent with other studies in the literature. (2,8,21–23). In the literature, a conservative approach is generally recommended for small lesions that do not exceed half the distance between the amelodentinal junction and the pulp (compatible with Grade 1). It is considered appropriate to monitor such lesions radiographically before eruption and to apply restorative treatment after the tooth eruption, if the lesion does not show a progressive character (24). On the other hand, it is emphasized that in larger lesions, especially if there is a long time left for the tooth to erupt and the resorptive process is progressive, intervention should be made before reaching the pulp (16,22). In such cases, treatment options may vary depending on the size and progression rate of the lesion, from fissure sealants and coronal restorations to indirect pulp capping, vital pulp treatments such as pulpotomy and revascularization, or extraction if necessary (25,26).

When the possible etiological factors related to PEIR were examined in this study, no predisposing factor was detected in most cases (90.9%). The most frequently observed potential factor was the primary tooth extraction on the relevant permanent tooth (3.4%). Factors such as ectopic location, caries in the primary tooth, periapical lesion, or endodontic treatment were recorded in lower rates (1.1%–2.3%). It is suggested in the literature that the PEIR defect may develop due to local infection in the primary tooth above it (27,28). The current findings partially support this hypothesis, since a significant portion of the teeth with PEIR have a history of extraction, periapical lesion, or treatment in the upper primary tooth. However, this theory does not explain PEIR cases in permanent molars without primary teeth. This study also detected PEIR defects in molars without primary teeth. On the other hand, as Seow et al. (29) stated, local factors such as ectopic location may also play a role in etiology. Although it has been suggested that ectopic location may lead to dentin resorption through pressure on the dental follicle, ectopic location was detected in only one case in our study, and no significant relationship was shown between ectopia and PEIR. These findings are parallel to the study results by Gültekin et al.(8).

Findings in the literature suggest that PEIR may be related to local or developmental factors rather than systemic factors (16). Gurunathan et al. (7) found no relationship with systemic factors. In addition, in one study, only one tooth was affected in all cases (2). In the studies conducted by Özden and Açıkgöz (17), Uzun et al. (6), and Gültekin et al. (8), single tooth involvement was predominant. This suggests that local factors may play a role in forming PEIR. Similarly, in the current study, only one tooth was affected in 45 of 64 cases with PEIR. However, there are also cases with multiple tooth involvement. In line with all these findings, it can be said that PEIR has a multifactorial structure and its etiology has not yet been fully elucidated (2).

This study has some limitations. First, only panoramic radiographs may not fully assess the three-dimensional structure of PEIR lesions and may result in small lesions being overlooked. In addition, the study is based on patient records from a single center, which limits the generalizability of the findings to larger populations. The lack of clinical follow-up data prevented the evaluation of dynamic processes such as the progression of lesions and their response to treatment.

Conclusion

This study revealed the prevalence, characteristics, and possible associated factors of PEIR lesions in children. The prevalence of PEIR in unerupted teeth was 0.34%, and at least one affected tooth was detected in 3.4% of the

evaluated individuals. Although no clear etiological factor could be identified in most cases, early extraction of the primary tooth adjacent to the affected permanent tooth was the most frequently observed potential factor. Careful radiographic evaluation of unerupted teeth and increasing awareness of PEIR may facilitate early recognition of these lesions and timely management with appropriate treatment.

Authorship Contributions: Concept: Z.Ö.; Design: Z.Ö.; Supervision: Z.Ö., S.S.; Data: Z.Ö., S.S.; Analysis: Z.Ö.; Literature search: Z.Ö., S.S.; Writing: Z.Ö., S.S.; Critical revision: Z.Ö.; S.S.

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Conflict of Interest: None declared.

Ethical Approval: The study protocol was approved by the Bolu Abant İzzet Baysal University Ethics Commitee (date: 09.07.2024 protocol no: 2024/168).

Informed consent: Written informed consent was obtained from patients who participated in this study.

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