

Radiographic Evaluation and Prevalence of Pre-eruptive Intracoronary Resorption in Patients attending a Tertiary Oral Healthcare Centre: A Retrospective Study from Southern India

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ABSTRACT

Introduction: Pre-eruptive Intracoronary Resorption (PEIR) is an asymptomatic lesion seen within the coronal dentinal tissue of non-erupted teeth, as radiolucent lesions and is often well-defined. This is an under recognised phenomenon and goes unnoticed due to a lack of awareness amongst clinicians. The present study was thus conducted to assess the prevalence of PEIR in patients attending a tertiary oral healthcare centre in Southern India.

Aim: The present study was conducted to assess the prevalence of PEIR in patients attending a tertiary oral healthcare centre in Southern India.

Materials and Methods: The present retrospective study was conducted in Saveetha Dental College and Hospitals, Chennai, Tamil Nadu, India, over a period of three years (January 2021–December 2023). After obtaining clearance from the Institutional Human Ethical Committee, 472 panoramic radiographs with at least one unerupted tooth were analysed. The data pertaining to age, gender, number of teeth, and presence or absence

of PEIR were extracted and tabulated in Microsoft Excel Spreadsheet 2021. IBM Statistical Package for Social Sciences (SPSS) version 26 was used to analyse the data. Cohen kappa statistics assessed the inter-observer agreement. The difference in the groups was estimated using the Chi-square test. Any value less than or equal to 0.05 was considered as statistically significant.

Results: The present study involved 472 subjects (14,169 teeth), and a total of 34 individuals exhibited PEIR in 34 teeth, resulting in a prevalence of 7.2% among the subjects and 0.24% at the tooth level. The male-to-female ratio was approximately 0.96:1, with 231 males and 241 females. The mandibular third molars were the most commonly affected, followed by maxillary third molars and maxillary canines, while no instances of PEIR were observed in the upper and lower incisors.

Conclusion: PEIR is a rare anomaly, with a tooth prevalence of a mere 0.24% in the present study. Early diagnosis and awareness may help prompt treatment planning, avoid potential consequences, and improve patient outcomes in dental practice.

Keywords: Asymptomatic lesions, Orthopantomography, Radiolucency, Tooth resorption

INTRODUCTION

Resorption of teeth is a commonly encountered phenomenon in dental clinics, and it can affect either the roots or the crowns [1-3]. PEIR (or radiolucencies/defects) are asymptomatic lesions within the coronal dentinal tissue of non-erupted teeth, they are radiolucent and often well-defined [4]. Previously described under various terminologies, this condition was originally described by Skillen in 1941 [5]. During normal radiography examination, PEIR is detected incidentally in the crown of unerupted teeth as radiolucencies, mainly in the dentin beneath the Dentino Enamel Junction (DEJ), which is extremely challenging to detect and treat [6,7]. The pathogenesis of PEIR remains obscure, and it has been correlated with a break in the continuity of the Nasmyth membrane covering the tooth germ, assisted by ectopic pressure/positioning of teeth, resulting in the initiation of a cascade of events that result in the resorption of the calcified structures of teeth [8]. The notion is aided by a few studies where the teeth have been submitted for histopathological examination. The submitted tissue showed fibrous connective tissue with multinucleated osteoclast like resorption cells and an inflammatory reaction [6,9,10].

The data across the different nations globally show variability in the prevalence of PEIR, which may be attributed to a general lack of awareness about the condition among general dentists. While the highest prevalence was reported by Nik NN and Abul Rahman R

in the Malaysian population, other studies from India and China reported the lowest prevalence of PEIR [11-13]. Most of the reported studies belong to Turkey, Australia, and a few from India [7,11,14-17]. Screening of unerupted permanent teeth during radiographic examinations can assist dentists in identifying these lesions in the early stages.

Currently, there is no universally acceptable protocol to treat PEIR. Root canal therapy, extraction, and restoration of the defect are recommended courses of action [18,19]. Most authors advocate a cautious approach, watching the lesion until the tooth erupts in non-progressive (or static) lesions. In contrast, active treatment should begin in cases that are categorised as progressive (developing) to prevent tooth loss. Further, in a few cases, when a big lesion is discovered, and the tooth eruption is not anticipated, it may be appropriate to elevate the flap, followed by curettage of the defect. The appropriate treatments for pulp exposure are pulp covering and glass ionomer cement restoration [19]. Extraction may be necessary if the lesion is large or causing symptoms.

The literature employs various methods to diagnose PEIR, such as bitewing radiographs, Orthopantomograms (OPG), and Cone Beam Computed Tomography (CBCT). The reliability of these techniques is variable, with minimal data available on CBCT. Few authors favour CBCT, while most of the other reported studies have used OPG to diagnose PEIR, attributed to the fact that OPGs yield a panoramic

view of the entire dentition in a single film with less financial burden and lower radiation exposure to the patient [16,20].

A comprehensive review of the literature regarding prevalence studies from India yielded only three previously published studies, deciphering a lack of awareness among dentists [11,16,17]. Further, rendering a correct diagnosis may be complicated by the fact that, radiologically, it may resemble Turner's teeth and the early stages of internal enamel pearls [15,21]. The main aim of the present study was to assess the overall prevalence of PEIR. Further, it was intended to individually assess the subject and tooth prevalence, along with reporting of the histological features, wherever available, to shed light on the pathological mechanism.

MATERIALS AND METHODS

The present retrospective study was conducted in Saveetha Dental College and Hospitals, Chennai, over a period of three years (January 2021- December 2023). After seeking clearance from the Institutional Human Ethical Clearance Committee (clearance number: IHEC/SDC/UG-2110/24/OPATH/128), data were retrieved from the institutional electronic database. Over three years, all six hundred panoramic radiographs were retrieved from the institutional electronic database. It was a time bound study and all the 600 radiographs were considered, to avoid dilution or missing data.

Inclusion criteria: 1) panoramic radiographs of optimal diagnostic quality; 2) panoramic radiographs with at least one unerupted tooth; and 3) panoramic diagnostic radiographs taken for routine orthodontic diagnosis, endodontic procedures, surgical removal of impacted teeth, assessment of missing teeth/delayed eruption, supernumerary teeth, or fusion.

Exclusion criteria: All radiographs of poor quality with a lack of clarity were excluded.

Study Procedure

Out of 600 retrieved radiographs, 128 were excluded because of poor quality. Finally, 472 panoramic radiographs of sufficient quality were included in the study. All 472 radiographs were evaluated for the calibration and presence/absence of PEIR by two authors (DP and RPK) individually. The data about age, gender, number of incisors, canine, premolars and molars, presence of PEIR, tooth affected by PEIR, and histopathological details, if any, were retrieved.

STATISTICAL ANALYSIS

The data were recorded in a Microsoft Excel spreadsheet (2021) and analysed using IBM SPSS Statistics for Windows, Version 26.0 (Released 2019; IBM Corp., Armonk, New York, United States). Mean and standard deviation were calculated on a Microsoft Excel sheet. The difference in the groups was estimated using the Chi-square test. A value less than or equal to 0.05 was considered statistically significant. The interobserver agreement was assessed by Cohen's kappa statistics [22]. The agreement levels between the authors are classified as no agreement (0-0.20), minimal agreement (0.21-0.39), weak agreement (0.40-0.59), moderate agreement (0.60-0.79), strong agreement (0.80-0.90) and almost perfect (above 0.90).

RESULTS

Subject characteristics: Four hundred and seventy two panoramic radiographs, obtained from the institutional electronic database, were retrieved and analysed. A Kappa value of 0.845 was obtained, signifying a strong inter-rater agreement between the observers (p -value <0.001). The mean age of patients without PEIR ($n=438$) was 25.81 years (± 12.42), while it was 24.85 \pm 13.59 years for the patients with PEIR ($n=34$). However, the difference in means was not statistically significant (p -value=0.667). The study sample included an almost equal number of males and females. There were 231 males and 241 females, which yielded a male-to-female ratio

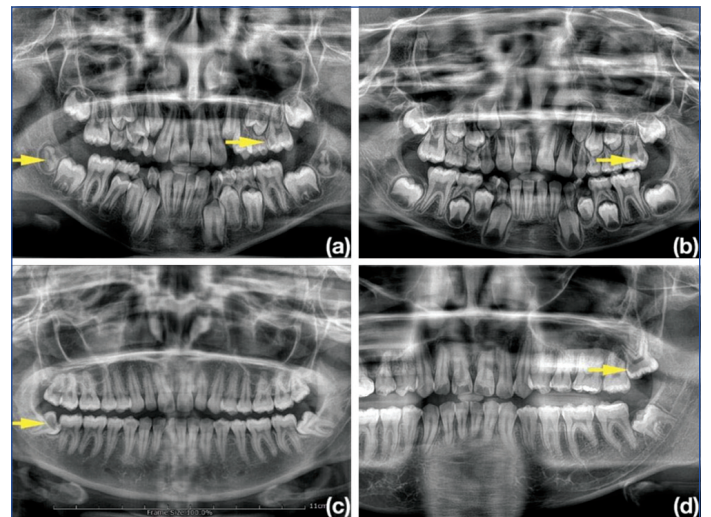
of 0.96:1. In total, 14169 teeth were examined, including 3624 incisors, 2017 canines, 3603 premolars and 4925 molars.

Subject and tooth prevalence: Out of 472 subjects, 34 individuals exhibited pre-eruptive intracoronal radiolucencies, resulting in a subject prevalence of 7.203%. Similarly, the tooth prevalence was estimated. A 34/14169 teeth showed PEIR, yielding a tooth prevalence of 0.24%. There were 215 males (49.1%) in the group without PEIR, and 16/34 males showed PEIR (47.1%). Similarly, 50.9% and 52.9% of females were without PEIR and with PEIR, respectively. The difference was not statistically significant (p -value=0.860) [Table/Fig-1].

Gender	Without PEIR (n=438)	With PEIR (n=34)	p-value (Chi-square test)
Male	215 (49.1%)	16 (47.1%)	0.860 (not-significant) Pearson Chi-square value- 0.052
Female	223 (50.9%)	18 (52.9%)	

[Table/Fig-1]: Percentage and comparison of cases with Pre-Eruptive Intracoronal Resorption (PEIR) and without PEIR, segregated gender-wise. Test applied- Chi square test, $p < 0.05$ considered significant (Pearson Chi-square value- 0.052; p -value=0.860)

Out of 34 involved teeth, third molars were most frequently affected, followed by canines, while no instances of PEIR were observed in the upper and lower incisors [Table/Fig-2].



[Table/Fig-2]: Panoramic radiographs showing PEIR in four different cases. PEIR is marked with yellow arrows.

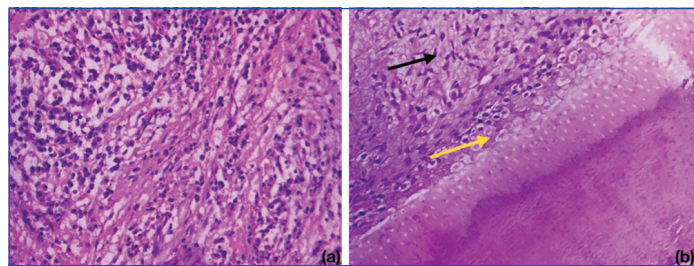
Maxillary teeth were seen affected more commonly than the mandibular teeth (19 maxillary: 15 mandibular; 1.27:1). In descending order, the commonly affected teeth were: mandibular third molar (11/34), maxillary third molars (8/34), maxillary first molars (6/34), mandibular first premolar (3/34), maxillary canines (3/34), mandibular canine (1/34), maxillary second molar (1/34), maxillary first premolar (1/34) [Table/Fig-3].

Teeth affected	Arch	No. of teeth affected	Percentage
M3	Mandible	11/34	32.36%
M3	Maxilla	8/34	23.53%
M1	Maxilla	6/34	17.65%
PM1	Mandible	3/34	8.82%
C	Maxilla	3/34	8.82%
C	Mandible	1/34	2.94%
M2	Maxillary	1/34	2.94%
PM1	Maxilla	1/34	2.94%

[Table/Fig-3]: Number and percentage of teeth showing Pre-Eruptive Intracoronal Resorption (PEIR); M3: third molar; M2: second molar; M1: first molar; PM1: first premolar; C: canine.

Histopathology: Histopathological data could be retrieved for three cases. The Haematoxylin and Eosin-stained sections (H&E) showed

loose connective tissue with mild to moderate chronic inflammatory reaction [Table/Fig-4]. The adjacent dentin showed jagged borders, suggestive of a resorptive process, with normal-appearing adjacent loose ectomesenchymal tissue.



[Table/Fig-4]: Photomicrographs of histopathological sections (H&E) showing mature stroma with moderate lymphoplasmacytic infiltrate (a, 40x), and loose ectomesenchymal tissue (black arrow) with adjacent resorbing dentin-yellow arrow (b, 40x).

DISCUSSION

Human dentition shows wide variation in formation and morphology, which varies amongst different races and ethnicities [23,24]. Similarly, there is a great variation in the reported anomalies. PEIR remains an underdiagnosed condition, with little awareness among general dentists. This is ascribed to the fact that most cases of PEIR are asymptomatic and incidental, and the diagnostic radiographs are not routinely screened. Nonetheless, dentists must be familiar with the entity for early detection and to prevent involvement of the dental pulp. The studies have been conducted across the globe and have shown a great variation in the prevalence of PEIR, with limited studies from India [7,9-15]. The present study was thus devised to report the prevalence of PEIR from a cohort of the South Indian population with histopathological analysis, wherever available, to shed light on the plausible pathogenesis.

A literature search showed the highest percentage of studies were conducted in Turkey, Australia and India [4,7,11,14-17,20,25]. Less frequently, data were available from Malaysia, Jordan, China, Israel, Thailand, Korea, Hungary and Japan [8,12,13,19,26-29]. The present study, employed OPG for the analysis and characterisation of PEIR. Apart from OPGs, bitewings and CBCT are used in a few studies [7,14,20,26,30]. OPGs were used in the present study as these were the most commonly used diagnostic imaging techniques with ease of availability. Further, as aforementioned, OPGs are comparatively more cost-effective and give a panoramic view of the entire dentition in a single film with comparatively lower radiation exposure. A slight predilection for the female gender in the current study. This is in accordance with the published data [7,8,25-28]. In contrast, the other studies showed a male preponderance, including the previous Indian studies [11-13,15,16,19]. Data about gender were not available in another study [29].

The overall subject prevalence in the present study was found to be 7.203%. Data retrieved showed a range of 0.5 to 27.31%, with the lowest prevalence reported from South India and the highest subject prevalence reported by Nik NN and Abul Rahman R in a cohort of the Malaysian population, indicating a difference and a role of ethnicity [11,12]. Similarly, when the tooth prevalence was estimated, 34/14169 teeth showed PEIR (prevalence-0.24%). Wang Y et al., reported the lowest tooth prevalence in the Chinese population, while the highest tooth prevalence was seen in the Turkish cohort [13,20]. A great variation was noted in the reported prevalence of PEIR, which may not only be attributed to the difference in ethnicity but also the variegated methods used for analysis [15,16]. Captivatingly, the subject and tooth prevalence were not proportionate in the reported cases because of the inequality in the number of subjects demonstrating PEIR and the number of teeth showing PEIR. For instance, in a study by Nik NN and Abul Rahman R the number of included subjects was 1007, and 275/1007 subjects showed PEIR, yielding a higher subject prevalence [12]. However, a higher number of teeth were examined (14554), causing varied tooth prevalence

[12]. In contrast, the other studies examined 3-4 times more teeth, yielding differences in prevalence amongst different ethnic groups.

In contrast to most previous studies, the maxillary arch was more commonly affected than the mandibular arch. The data about the tooth segment also yielded variable results from the literature. The data showed that the third molars were the most frequently affected teeth; other reports, however, showed that the canines and premolars were the most commonly affected teeth [12,28]. The higher involvement of third molars could be explained based on the fact that we included patients with a wider age range, while most other studies included only children and adolescents. It must also be emphasised that the most commonly affected set of teeth, including the third molar, premolars and canines, are also the most common ectopically erupted or missing teeth, suggesting the role of ectopic positioning and abnormal pressure in the pathogenesis of PEIR [8,31,32]. Interestingly, PEIR is also reported in supernumerary teeth, which also favours the role of ectopic positioning, and abnormal development of teeth could be an important factor in the genesis of PEIR [25,26].

Data regarding the histopathological analysis of PEIR is puny. Seow WK et al., and Klambani M et al., histologically demonstrated chronic inflammatory infiltrate and multinucleated giant cells, suggesting a resorptive aetiology [7,33]. If this theory were to be accepted, the source of the resorptive cells could be undifferentiated mesenchymal cells from dental pulp. Other studies have demonstrated granulation tissue, foamy macrophages, fibrous connective tissue without osteoclasts and inactive dental rests in the examined tissue [10,21,34,35]. These features favour a reparative process. One single report showed the presence of adipocytes in the defect [36]. In the current study, mild to moderate inflammatory reaction and rich vasculature resembling granulation tissue were demonstrated. It may be prudent to believe that the different histological features may be a continuum spectrum of the same process, while resorption occurs in the initial phase, healing by granulation tissue, reparative dentine, or fibrous tissue might represent the late stage. Although no direct studies have been reported about the presence of fat in the pulp, the role of leptins and other adipokines, which have a significant role in regeneration, has been well studied [37]. Treatment of PEIR is personalised, with various options such as glass ionomer cement, root canal, extraction or 'wait and watch' [18,19].

Limitation(s)

Although here, baseline data based on a hospital-based database was provided, there are a few limitations of the study. First, the location and extent could not be determined clearly on OPGs. Secondly, the data were retrieved from the database of a single institute with a smaller sample size, and thus, the results may not be generalised to the entire population. Thirdly, the material from all affected teeth could not be examined histopathologically to provide more generalised results. A genetic analysis would help further clarify the exact mechanism of PEIR.

CONCLUSION(S)

The PEIR is a rare, underdiagnosed but clinically severe dental defect that needs to be carefully evaluated radiologically and managed appropriately. In the present study, it was found that the subject and tooth prevalence of 7.203 and 0.24%, respectively. The third molars were the most frequently affected teeth, followed by maxillary first molars, mandibular first premolars and maxillary canines. Potential consequences from these lesions must be avoided by early detection and proper care. Awareness of this entity is required among general dentists.

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