Treatment of pre-eruptive intracoronal resorption: A scoping review

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DOI 10.23804/ejpd.2020.21.03.13

Abstract

**Aim** Pre-eruptive intra-coronal resorption (PEIR) is a rare condition that can affect children’s dentition. Showing the same aspect of dental caries, these lesions are diagnosed in non-erupted teeth. The aetiology is not yet defined and no consensus on their treatment is available. Thus, the aim of the present scoping review of the literature was to try to establish a protocol for treatment and management of PEIR defects.

**Methods** The search was performed on Medline via PubMed, Science Direct and EBSCOhost’s databases using the appropriate Medical Subject Headings (MeSH) terms. Studies that described the PEIR were considered eligible and the data from the selected papers were extracted and analysed independently by two authors.

**Results** Out of 172 articles identified in initial research, 15 articles were selected for reviewing. Interventions varied from preventive treatment to extraction, depending on the lesion severity and its proximity to the pulp.

**Conclusion** Non-operative procedures, conservative approaches and extractions were recommended for the management of PEIR, depending on the extent of the lesions. Overall, further researches should be conducted to explore the effectiveness of the approaches of PEIR management.

**KEYWORDS** Pre-eruptive; Intra-coronal resorption; Intra-coronal radiolucency; Occult caries; Children.

Introduction

Pre-eruptive intracorony resorption (PEIR) or pre-eruptive intracoronal lesion was firstly described as intra-follicular decay. However, this illustration has changed because dental caries cannot affect an unerupted tooth [Kronfeld, 1955]. The lesion was defined as a radiographic radiolucency, in the dentin of the crown of an unerupted tooth just below the enamel-dentin junction [Counihan et al., 2012; Wong et al., 2014]. Yamada et al. [2001] found multinucleated cells which had cathepsin-k immunoreactivity as an indicator of the resorptive activity of giant cells, in the cytoplasm. These findings suggested that the resorption process can progress if there are no appropriate treatments.

McNamara et al. [1997] also reported areas repaired with a spongy bone that was reshaped in places into lamellar bone. O’Neal [1997] and Şahin et al. [2015] described the presence of inflammatory cells including lymphocytic cells, an edematous matrix and some vascular ducts surrounded by hyalinotic connective tissue.

The diagnosis of PEIR’s lesions is most of time fortuitous and determined through radiographs due to the absence of clinical signs [Ilha et al., 2018], but some cases of associated pain have been reported in the literature [Brunet-Llobet et al., 2014; Yang et al., 2017].

For the clinical aspect, most cases reported in the literature were without any apparent lesion [Counihan et al., 2012; Czannecki et al., 2014; Yamana et al., 2010], but in some cases the lesion was clinically obvious [De Souza et al., 2017; Manan et al., 2012; Omar et al., 2015] and the surrounding tissues were generally of normal appearance [Fiorentin et al., 2016; Yamana et al., 2010].

Several treatments have been proposed for these lesions but no consensus on a rigorous therapeutic strategy has been yet established.

The main objective of this scoping review was to provide dentists with a clinical guide for the management of teeth with pre-eruptive intracoronal resorption.

Methods

**Research question**

This scoping review was developed following the recommendations of Arksey and O’Malley and aimed to answer the following question: What are the treatment modalities of PEIR lesion?
Identifying the relevant studies and information

Search strategy

Databases search was conducted from June 15, 2008 to June 12, 2018 and updated on December 11, 2019 to identify all published studies discussing therapeutic modalities of pre-eruptive intra-coronal resorption in a paediatric population (patients under 18 years of age). The research has covered Medline via PubMed, Cochrane Central, ScienceDirect and EBSCOhost. Pre-eruptive intra-coronal resorption was not indexed as MeSH terms; hence the following set of keywords was used during the search through different user combinations: “Tooth unerupted”, “Tooth resorption”, “Tooth crown”, “Intracoronal”, “Radiolucenty”, “Dental radiography”, “Tooth Diseases”.

Inclusion/exclusion criteria

The studies were initially screened based on title and abstract according to the following inclusion criteria: Case report related to PEIR with clear description and diagnosis of PEIR and its management details; tooth number, clinical and radiographic exam, surgical and/or restorative treatment, treatment’s results and follow-up of at least 3 months; in patients aged less than 18 years; published in English.

The exclusion criteria included: publications before 2008, retrospective studies, duplicates, editorials, irrelevant papers, articles not in English, and those with unavailable data.

Data charting

The titles of all studies were reviewed by two authors independently. Duplicate studies were excluded. After titles selection, the abstracts were reviewed. Studies were excluded when they did not discuss any therapeutic modalities of PEIR. Cohen’s k statistic was done with value of 0.92 and 96.29% of agreement. Disagreement was solved by a third evaluator.

A data extraction sheet for the included articles was developed by the reviewers and the following items were collected: Identification of the article (author and year); number and age of children; type of teeth with pre-eruptive intracoronal resorption; intervention (timing, modalities, procedures); treatment’s results.

Results

Study selection

The search strategy yielded a total of 172 articles from four search engines, PubMed via MEDLINE (127), Cochrane central (15), ScienceDirect (17), EBSCOhost (14) which were imported into Medley. Of the 172 references initially identified, 18 were duplicates, and 137 records were excluded by screening for title and abstract. Thirteen articles were added from grey literature and 9 articles were excluded. The remaining 21 articles were selected for full text review, after which, 6 studies were eliminated based on the exclusion criteria and 15 articles were chosen for assessment (Fig. 1) (Table 1).

<table>
<thead>
<tr>
<th>Reference</th>
<th>Authors</th>
<th>Type of article</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yamana et al.</td>
<td>Case report</td>
<td>2010</td>
</tr>
<tr>
<td>2</td>
<td>Yaqobb et al.</td>
<td>Case report</td>
<td>2011</td>
</tr>
<tr>
<td>3</td>
<td>Counihan, O’Connell</td>
<td>Case report</td>
<td>2012</td>
</tr>
<tr>
<td>4</td>
<td>Manan et al.</td>
<td>Case report</td>
<td>2012</td>
</tr>
<tr>
<td>5</td>
<td>Brunet-Llobet et al.</td>
<td>Case report</td>
<td>2014</td>
</tr>
<tr>
<td>6</td>
<td>Czarnecki et al.</td>
<td>Case report</td>
<td>2014</td>
</tr>
<tr>
<td>7</td>
<td>Wong, Khan</td>
<td>Case report</td>
<td>2014</td>
</tr>
<tr>
<td>8</td>
<td>Omar et al.</td>
<td>Case report</td>
<td>2015</td>
</tr>
<tr>
<td>9</td>
<td>Ahn et al.</td>
<td>Case report</td>
<td>2016</td>
</tr>
<tr>
<td>10</td>
<td>Fiorentin Moura et al.</td>
<td>Case report</td>
<td>2016</td>
</tr>
<tr>
<td>11</td>
<td>Barra SG, et al</td>
<td>Case report</td>
<td>2017</td>
</tr>
<tr>
<td>12</td>
<td>Mannmontri et al.</td>
<td>Case report</td>
<td>2017</td>
</tr>
<tr>
<td>13</td>
<td>De Souza et al.</td>
<td>Case report</td>
<td>2017</td>
</tr>
<tr>
<td>14</td>
<td>Yang et al.</td>
<td>Case report</td>
<td>2017</td>
</tr>
<tr>
<td>15</td>
<td>Ilha et al.</td>
<td>Case report</td>
<td>2018</td>
</tr>
</tbody>
</table>

TABLE 1 Articles considered for reviewing.
Study characteristics

The retained studies described the clinical management of teeth affected by PEIR lesions in children aged between 2010 and 2018. The included articles were published between 2010 and 2018. The main characteristics of the included studies are shown in Tables 2, 3, and 4. All cases of pre-eruptive intracoronary resorption were discovered prior to the eruption except for the case reported by Manan et al. (2012) where the diagnosis was established just at the eruption time. For all the included cases, the diagnosis was fortuitous. Panoramic radiographs were used for diagnosis in 11 cases and in 2 cases only bite-wing radiographs were used. All patients had only one tooth with pre-eruptive intracoronary resorption except one case where the patient had 2 affected teeth.

The degree of alteration according to The Seow classification (Seow et al., 1999b) was as follows: degree I for 5 teeth, degree II for 5 teeth and degree III for 9 teeth. The localisation of lesions was: mesial, distal and occlusal respectively for 5 teeth, mesio-occlusal or occluso-distal for three teeth, all the crown for 3 teeth and all dentinal thickness for other four ones. The clinical management of PEIR defects depends mainly on the lesion size and degree of progression at the time of detection but other factors may influence the treatment plan such as the stage of root development and the proximity of the successor germ.

In this scoping review, treatments described by the authors were diverse and varied from a preventive approach to extraction.

Main outcomes

In order to have a clear vision when interpreting the results of the included articles, we tried to group the findings according to the lesion degree.

Lesion degree I

For degree 1 lesion, a follow-up approach was always

<table>
<thead>
<tr>
<th>Author/ year</th>
<th>Age/ gender</th>
<th>Dent.</th>
<th>Tooth</th>
<th>Localisation</th>
<th>Eruption status</th>
<th>Diagnostic method</th>
<th>Time of intervention</th>
<th>Intervention</th>
<th>Follow-up (months)</th>
<th>Clinical outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counihan, O’Connell (2012)</td>
<td>6y Female</td>
<td>Mixed</td>
<td>46</td>
<td>Distal</td>
<td>Partially erupted</td>
<td>Bitewing</td>
<td>Before eruption</td>
<td>Sealant + monitoring</td>
<td>62</td>
<td>No caries Vital tooth</td>
</tr>
<tr>
<td>Czarnecki et al. (2014)</td>
<td>4y 3m Female</td>
<td>Primary</td>
<td>46</td>
<td>Central</td>
<td>Unerupted</td>
<td>Periapical radiograph</td>
<td>Before eruption</td>
<td>Surgical exposure + sealant</td>
<td>44 (33 months after treatment)</td>
<td>No caries The lesion was stabilised</td>
</tr>
<tr>
<td>Ahn et al. (2016)</td>
<td>11y Female</td>
<td>Mixed</td>
<td>47</td>
<td>Median</td>
<td>Partially erupted</td>
<td>Panoramic radiograph</td>
<td>Before eruption</td>
<td>Preventive obturation with bulk-fill + sealant</td>
<td>12</td>
<td>No clinical signs of complication</td>
</tr>
<tr>
<td>Barra et al. (2017)</td>
<td>9y Female</td>
<td>Mixed</td>
<td>45</td>
<td>Mesial</td>
<td>Unerupted</td>
<td>Panoramic radiograph</td>
<td>Before eruption</td>
<td>Abstention Wait and see? / Follow-up + indirect pulp capping</td>
<td>48</td>
<td>No progression of the lesion</td>
</tr>
</tbody>
</table>

TABLE 2 Data extraction of lesion degree I of Seow.

<table>
<thead>
<tr>
<th>Author/year</th>
<th>Age/ Gender</th>
<th>Dent.</th>
<th>Tooth</th>
<th>Localisation</th>
<th>Eruption status</th>
<th>Diagnostic method</th>
<th>Time of intervention</th>
<th>Intervention</th>
<th>Follow-up (months)</th>
<th>Clinical outcomes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counihan, O’Connell (2012)</td>
<td>10 y Female</td>
<td>Mixed</td>
<td>45</td>
<td>Mesial</td>
<td>Unerupted</td>
<td>Panoramic radiograph</td>
<td>After eruption</td>
<td>Indirect cupping + resin modified glass ionomer + composite resin + sealant</td>
<td>72 months</td>
<td>Root edification is purchased and tooth is asymptomatic</td>
</tr>
<tr>
<td>Moura et al. (2016)</td>
<td>14y Female</td>
<td>Mixed</td>
<td>37</td>
<td>Median</td>
<td>Partially erupted</td>
<td>Panoramic radiograph</td>
<td>Before eruption and purchased after</td>
<td>Before eruption Elimination of affected tissue + glass ionomer cement. After the eruption: glass ionomer cement+ resin composite</td>
<td>9 months</td>
<td>Vital tooth, no clinical or radiological signs of complication</td>
</tr>
<tr>
<td>Mannmontri et al. (2017)</td>
<td>8y 8 male</td>
<td>Mixed</td>
<td>37</td>
<td>Distal</td>
<td>Unerupted</td>
<td>Panoramic radiograph</td>
<td>After eruption</td>
<td>Sealant + Monitoring</td>
<td>104 months</td>
<td>Lesion is stabilized and tooth is asymptomatic</td>
</tr>
<tr>
<td>DeSouza et al. (2017)</td>
<td>10y Male</td>
<td>Mixed</td>
<td>35</td>
<td>Mesial</td>
<td>Erupted</td>
<td>Panoramic radiograph</td>
<td>After eruption (after 3 months)</td>
<td>Restoration with Bulk-fill composite</td>
<td>12 months</td>
<td>No progression of the lesion</td>
</tr>
<tr>
<td>Ilha et al. (2018)</td>
<td>8y Female</td>
<td>Mixed</td>
<td>36</td>
<td>Mesial</td>
<td>Unerupted</td>
<td>Panoramic radiograph</td>
<td>After eruption (after 6 months)</td>
<td>Surgical exposure + Restoration with glass ionomer cement+ resin composite</td>
<td>18 months</td>
<td>No clinical or radiological signs of complication</td>
</tr>
</tbody>
</table>

TABLE 3 Data extraction of lesion degree II of Seow.
recommended. A conservative approach with periodic clinical and radiographic follow-up is recommended in non-progressive lesions and intervention can be postponed until after tooth eruption when treatment does not require immediate surgical intervention. The prognosis of these lesions is often favourable, with generally no complications.

Sealant

In the second clinical case reported by Counihan and O’Connell [2012], intra-coronal radiolucency in a partially erupted lower right first permanent molar was noted on baseline bite-wing radiographs of a 6-year-old girl. Due to the non-progressive aspect of the lesion, a resin sealant was applied after the eruption. The lesion was monitored annually and the tooth remained vital and asymptomatic, but at the age of 11 years the disto-lingual cusp overlying the PEIR lesion fractured and the tooth was restored using a preformed metal crown.

In the case report of Czarnecki et al. [2014], a non-progressive

**TABLE 4** Data extraction of lesion degree II of Seow.
PEIR lesion was detected early in non-erupted lower right first permanent molar of a 4-year-old girl. Treated with a preventive glass ionomer sealant before eruption in order to avoid bacterial invasion and monitored for 44 months, the tooth remained asymptomatic and vital. The glass ionomer sealant was used because it resists to humidity, releases fluoride, hardens quickly and requires little or no preparation.

Preventive filling
Ahn et al. [2014] reported a case of female patient aged 11 years with two affected teeth. The panoramic radiograph revealed that teeth 47 and 37 had PEIR lesion. Tooth 47 was palpable while tooth 37 was not, for which reason the treatment of tooth 47 was planned before the eruption and the 37 after it. After the tooth underwent gingival incision, bulk-fill composite resin and a glass ionomer cement-based sealant were placed. The patient was then lost of sight for more than a year before re-consultation and lesion on the 37 had evolved into a Grade II lesion, requiring indirect pulp capping which was done using TheraCal LC® and Biodentine®.

Lesion degree II
In order to stop the progression of the resorptive process and prevent its penetration into the dental pulp, immediate treatment by conservative approaches is generally recommended in degree 2 lesions, where the tooth is not close to eruption within a short time. The prognosis of all the included degree 2 lesions described in the present review was favourable.

Sealant
Manmontri et al. [2018] reported a case of a non-progressive PEIR lesion on a mandibular left second permanent molar of a 17-year-old boy. The lesion was initially detected at the age of 8 years, 8 months and was clinically and radiographically assessed yearly. Cone beam computed tomography was used to evaluate the lesion’s size and location. Due to the non-evolving nature of the detected PEIR during the nine-year follow-up, the patient’s low caries-risk status, and high patient and parental cooperation, it was decided to place resin sealant on the affected tooth and monitor the lesion without any operative treatment. In this case report, resin material was chosen as sealant to avoid the development of cavities added to pre-eruptive intracoronal resorption, causing significant destruction of the dental structure.

Coronary filling
Ilha et al. [2018] reported a case of degree II PEIR lesion in a left mandibular first permanent molar of an 8-year-old girl. After a 6-month follow-up, the lesion was removed and a restoration was made with glass ionomer cement (GIC). Six months later, the restoration was made with resin-based composite and the GIC was kept as a lining for the restoration. After a follow-up period of 18 months, there were no reports of pain.

Moura et al. [2016], described the clinical management of a permanent second molar presenting a PEIR lesion of a 14-year-old girl. Because of its pulp proximity, the lesion was treated immediately. The treatment decision involved surgical access for removal of the lesion followed by restoration of the coronal cavity. GIC was placed as a liner material and the restoration was made with resin composite.

De Souza et al. [2017] performed a coronary filling by posterior resin after the removal of PEIR defect detected in a mandibular second premolar of a 10-year-old boy.

Ilha et al. [2018] and De Souza et al. [2017], decided to wait for the tooth to erupt for the following reasons.

- Difficulty in controlling humidity and bleeding at surgery.
- The absence of pain or discomfort in addition to a nearly eruption of the tooth.

Indirect cupping
In the first case described by Counihan and O’Connell [2012], an intra-coronal radiolucency in an unerupted lower right second premolar was an incidental finding on orthopantomograph, of a 10-year-old girl. The lesion was monitored radiographically prior to and during eruption. The PEIR lesion did not increase in size and there was continued root development. Despite the fact that the tooth erupted without incident and was clinically sound an indirect pulp capping was performed.

Lesion degree III
If the lesion is very extensive or causing symptoms such as pain, pus discharge or swelling, the removal of the affected tooth may be the treatment of choice.

Indirect cupping
Yamana et al. [2010] described a severe PEIR lesion on an unerupted mandibular left first permanent molar of a 5-year-old girl. The radiographic findings demonstrated a wide radiolucent area in the coronal part of the affected molar, which extended close to the pulp. After a 12-month follow-up, the affected tooth had emerged into the oral cavity. A surgical removal of the gingival tissue showed that the affected tooth was intact. However, when the enamel of the corresponding tooth was removed, a hollow portion of approximately 2 mm into the tooth with no exposure was revealed. Calcium hydroxide was applied and restoration with cement was performed. Three months after treatment, the patient had no abnormal sign or symptoms.

Pulpotomy
In the reported case of Omar et al. [2015] of a PEIR lesion diagnosed on a permanent second molar in a 11-year-old-patient, a surgical exposure to the tooth before the eruption was done, then a partial pulpotomy with MTA at the pulp exposure site was performed. For restoration a Para Core material® and composite resin were placed after 8 weeks. The choice of the treatment was based on: The importance of the lesion (avoiding more dental destruction); The agenesis of the 4 wisdom teeth; The age of the patient that did not authorise the placement of an implant.

Revascularisation
Yang et al. [2017] described two cases of immature permanent teeth necrotised as a result of deterioration by degree III PEIR lesion. In the first case, the author reported a PEIR lesion on an unerupted left mandibular permanent canine of an 8-year-old girl. According to the clinical and radiological findings, the tooth was diagnosed with pulp necrosis and apical periodontitis. The treatment of choice was regenerative pulp treatment of the immature root. Mineral trioxide aggregate (MTA) was used as coronal seal, and a composite resin restoration was performed using resin-modified glass ionomer cement as a base. After a 6-month follow-up, no particular clinical symptoms and a normal appearance of the root apex were observed. At the 14-month follow-up examination, the patient did not exhibit any particular clinical signs. Furthermore, continued root development, in terms of length and thickness, was evident on the radiograph.

In the second case, a PEIR lesion on an unerupted left mandibular first premolar of an 8-year-old boy was diagnosed.
The tooth was impacted below the preceding primary molar, which make it difficult to intervene. Thus, the plan was made to wait for the tooth to erupt. At the 12-month follow-up, pulp necrosis of the immature tooth was diagnosed after clinical and radiographic examinations. After a tight coronal seal formed by MTA was placed, a composite resin restoration of the left mandibular first premolar was performed. At the 3-month follow-up, no particular clinical symptoms were observed.

Extraction
Five teeth presented with PEIR lesions were extracted [Counihan et al., 2012; Llobet et al., 2014; Manan et al., 2012; Wong et al., 2014; Yaqoob et al., 2011] including tooth 37 that caused left mandibular pain. Based on the extent of the lesion and the unfavourable prognosis of the teeth, extraction was performed.

Manan et al. [2012] described a case of PEIR lesion on an erupted right maxillary permanent canine in a 13-year-old boy. Following excisional biopsy, they decided to retain the right maxillary canine and monitor its progress. The patient was reviewed at frequent appointments over 18 months since the time there was radiographic evidence of resorption. And the author decided finally to keep the affected tooth in order to retain the alveolar bone height and width to allow for the option of planning for an implant.

Treatment outcomes
No clinical or radiological signs of complications have been reported after treatment of teeth affected by pre-eruptive intracoronal resorption. Recurrence of the resorption after curettage and restoration of the cavity has not been reported. The root development of the permanent immature teeth continued normally.

Czarnecki et al. [2014] described an increase in radiopacity at the base of the lesion compared to previous X-rays.

Yang et al. [2017] noted, for his second case, a decreasing of the apical image and a normal appearance of the apex.

Discussion
Pre-eruptive intracoronal resorption is considered as a challenge for the dentist, especially when the early diagnosis and timing of intervention are difficult to establish. Indeed, the unexpected evolution sometimes of such lesion [Czarnecki et al., 2014; Fiorentin et al., 2016] or even its unnoticed appearance in intact crown [Yaqoob et al., 2011] constitute the major challenge.

The age of the patients varied between 4 years (and 3 months) and 14 years which is the age of both formation and eruption of permanent teeth (except for the wisdom tooth) which explain the high frequency of mixed dentition (72.22%).

The diagnosis of intracoronal resorption occurred before the eruption or shortly after it, and this may help to confirm the diagnosis of PEIR lesions since the tooth is not yet invaded by bacterial agents and that a curious process cannot be the cause of the lesion.

The absence of associated clinical symptoms in most of the cases makes the clinical diagnosis difficult.

Five cases among eighteen were discovered by orthodontists.

Five cases among eighteen were discovered by orthodontists. And the most used X-ray in the diagnosis was panoramic radiographs. Therefore, pediatric dentists and orthodontists should be aware about the occurrence of these pre-eruptive lesions and should examine carefully dental radiographs involving non-erupted teeth, especially since the early diagnosis is of utmost importance for determination of the treatment plan and prognosis.

Treatment condition
In the developing dentition, the clinical management of these lesions is always considered as complex. Several factors should be considered by practitioners such as respect to root development, need for pulp therapy, possible loss of pulp vitality, longevity of a non-vital tooth and the real value of retaining a tooth; its early loss, may be critical in overall arch-form and occlusal function in some cases. Moreover, clinical management of PEIR defects depends mainly on lesion size and its rate of progression at the time of detection.

Clinical treatment can also be dictated by other factors: patient’s behaviour, age, cooperation for routine exams and oral environmental condition such as skeletal relation, spacing/crowding, hypodontia, and supernumerary teeth. The timing for intervention should be defined based on periodic radiographs in order to recognize the progressive and static defects. The rate of progression of PEIR defects varied even within the same patient. For this reason, it has been advised that the initial abnormality should prompt annual follow-up of the affected tooth and the other unerupted teeth.

Two type of classifications were used in the literature to classify these lesions, the classification of Seow et al. [1999a] was used for 2-dimensional radiographs and the classification of Demirtas et al. [2016a] for three-dimensional radiographs.

Treatment options described in the literature include restoration before eruption, restoration after eruption and extraction of the affected tooth. In the present scoping review, in order to suggest a protocol for treatment and management of PEIR defects, the lesions were classified according to the lesion’s degree.

Treatment of lesion degree I of Seow
For degree I lesions, a preventative and non-invasive approach was always recommended.

For the unerupted teeth, the lesion was often considered as non-evolving due to absence of bacterial invasion, for this reason, sealant was in most cases preferred after eruption. Preventive filling was also considered as an alternative approach and has the advantage of eliminating the entire lesion.

The timing of the intervention for these defects, was determined subjectively according to the personal judgment of the practitioners in most cases.

Czarnecki et al. [2014] chose to surgically expose the tooth before eruption to examine the integrity of the enamel surface and to perform a histological and microbiological examination.

Despite the fact that this attitude was not considered as advantageous for the patient.

The application of the sealant after the eruption could have been carried out in Counihan et al. [2012], especially since the lesion did not show any radiological signs of evolution.

For evolving lesions that require preventive filling, immediate treatment is recommended in order to avoid further tissue destruction and the need for more invasive filling, as did Ahn et al. [Ahn et al., 2014].

Despite a non-progression aspect, complications may occur in some cases. Indeed, Counihan [2012] reported a fracture in the disto-lingual cusp of the tooth, 5 years after the initial diagnosis, requiring the placement of performed stainless-steel crown. This complication was considered as a treatment failure.

The use of glass ionomer cement was recommended as
of the root [Kahler et al., 2014].

Regenerative endodontic therapy using calcium hydroxide and MTA has been shown to be more effective than apexification, and it has the same effect regarding the increase in length and thickness of the root.

In the first case reported by Yang et al. [2017], revascularisation was performed to treat a mandibular permanent canine with PEIR, and follow-up at 14 months revealed increased length and thickness of the root compared with the initial radiographic examination. Additionally, no sign or symptom of inflammation was detected. A positive response also was exhibited in electric pulp testing.

In extensive PEIR lesions, causing symptoms such as pain, swelling, or pus discharge, removal of the affected tooth may be the treatment of choice and orthodontic alignment to upright adjacent teeth may be required later.

The ideal time for extraction should be just prior to or just after eruption of the tooth, so that the procedure can be simple.

Bias risk

All the studies included in the present scoping review were case reports, which make the risk of bias very high with significant variability of age, ethnicity and socio-economic conditions. Moreover, the number of patients was very low: only 18 children were included, which can lead to a high risk of error especially in drawing conclusions. A bias of publication can be also considered because the elimination of a case report published in a language other than English was preceded.

Recommendations

When a PEIR lesion is diagnosed, the timing for intervention should be determined based on periodic radiographs in order to distinguish between a progressive lesion and a non-evolving one. Careful radiographic examination of young patient is always necessary. A follow-up period of 6 to 12 months is recommended to assess the progression rate of PEIR lesions. In degree I lesions, a follow-up approach is recommended.

A conservative approach with periodic clinical and radiographic follow-up could be recommended in non-progressive lesions. Intervention can be postponed until after tooth eruption when the lesion does not seem to endanger the pulp.

For lesions that have been confirmed as non-progressive, the practitioner may choose not to treat the lesion: however application of a sealant is recommended to avoid bacterial invasion and the addition of a carious lesion that may aggravate the pre-existing lesion.

Immediate treatment in degree II and III lesions is recommended. To stop the progression of the resorptive process, the surgical exposure is indicated if the tooth is not close to eruption within a short time. If there is no communication between the lesion and the pulp, indirect capping will be the treatment of choice. For pulp exposures, with inflammation-free tissue, direct pulp capping can be considered as the best treatment choice. Hydroxide calcium, MTA or Biodentine could be used in this case.

Revascularisation can be an interesting choice, in permanent immature teeth with large PEIR lesions.

If the lesion is very extensive and showing clinical or radiological signs of complication (pain, swelling, etc.) removal of the affected tooth may be the treatment of choice.

The material of choice for a coronary filling in the surgical phase is the glass ionomer cement, the use of the resin will be
The therapeutic options for treating pre-eruptive intracoronal resorption are presented in Figure 2.

**Conclusion**

Early diagnosis of PEIR defects allows early treatment. Panoramic radiographs allow a wide view of mostly unerupted teeth which explains their importance in the management of these lesions.

For therapeutic management, a conservative approach with meticulous clinical and radiographic follow-up are always recommended in non-progressive lesion and intervention can be postponed until after tooth eruption when treatment does not require surgical intervention.

The scoping review revealed gaps in the literature about a clear consensus of PEIR lesion treatment.

We recommend long-term prospective clinical studies and multiple researches in order to establish the aetiology of PEIR lesion and its effects on adjacent teeth.

**Conflicts of interest**

The authors declare no conflicts of interest.

**References**