



# The pararadicular radiolucency with vital pulp: Clinicopathologic features of 21 cemental tears

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**Objective.** The investigation was conducted to better characterize the clinical, radiographic, and histopathologic features of cemental tears from a review of 21 cases.

**Study Design.** This was a retrospective review of consecutive cases collected from patient records of the investigators.

**Results.** Twenty-one cases were identified during an 8-year period. Maxillary incisors were most often affected (47.6%). All lesions presented with pain. They occurred as radiolucencies along the root of a vital or endodontically treated tooth and were classified as D-shaped (38.1%), thin-vertical-line (23.8%), thick-vertical-line (14.3%), J-shaped (19.0%), or periapical radiolucencies (4.8%). All lesions showed focal destruction of the lamina dura, with 66.7% exhibiting extension into the medullary bone. Histopathologic diagnoses included intramedullary fibrous scar (28.6%) and chronic fibrosing osteomyelitis (71.4%), all associated with embedded cemental fragments. Five associated teeth were also examined: All showed tears beneath the remaining cementum. Four cases were successfully treated with curettage without tooth extraction; endodontic therapy was performed, probably mistakenly, in 8 cases.

**Conclusions.** Cemental tears produced symptomatic, localized chronic inflammation characterized usually by a vertical radiolucency adjacent to a root. These lesions may not be as rare as previously thought and extraction may not be the best treatment. (Oral Surg Oral Med Oral Pathol Oral Radiol 2019;128:680–689)

Cemental tears occur when a full-thickness layer of cementum is forcibly separated in vivo from the underlying root dentin as a result of excessive occlusal forces or trauma to the jaws.<sup>1-18</sup> The sheared-off cemental fragment remains within the periodontal ligament (PDL) for months or years, acting as a constant, movable irritant. This can result in a painless or minimally painful, low-grade inflammation of the PDL and surrounding bone. Some individuals apparently have a predisposition to this problem because of an unidentified developmental weakness in the fibers and/or adhesives connecting the cementum to the dentin at the cementum–dentin junction (CDJ).<sup>15</sup>

This entity presents an odd diagnostic dilemma because it seems to be considered only rarely in the differential diagnosis despite the fact that it typically has an obvious presentation. Lesions present a vertical radiolucency (D-shaped; thin, regular linear; thick, irregular linear; J-shaped; or periapical) with destroyed lamina dura (Figure 1), adjacent to the

lateral root surface of a vital tooth.<sup>17</sup> The occasional periapical lesion is more difficult to assess but cemental tears should always be suspected when the pulp tests vital.<sup>14</sup>

Until recently, the lesion appeared to be the rarest form of tooth fracture, with only a few dozen in vivo human cases reported since Lehm and Reissig published the first case in 1989.<sup>1-19</sup> However, a recent multicenter series of 71 cases suggested that it is perhaps not as rare as previously suspected and that some cases may be misdiagnosed as pulpal necrosis without appropriate pulp testing.<sup>20</sup> We have been able to identify, during an 8-year period, 21 well-documented, microscopically proven cases, some of which were presented previously.<sup>17,21,22</sup> Additionally, one of the investigators (J.E.B.) has observed hundreds of examples of extracted teeth with radicular areas of torn cementum, as illustrated in Figure 2, and all tears were located at the CDJ.

In this study, we attempted to better characterize this lesion and further enhance professional awareness of its diagnostic features because proper clinical diagnosis can prevent inappropriate treatment, especially unnecessary extraction of the affected

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## Statement of Clinical Relevance

The cemental tear is not well known and may mimic root fracture, apical infection, or periodontal disease. A better clinical understanding of its signs and symptoms is needed to provide the appropriate treatment and avoid misdiagnosis.

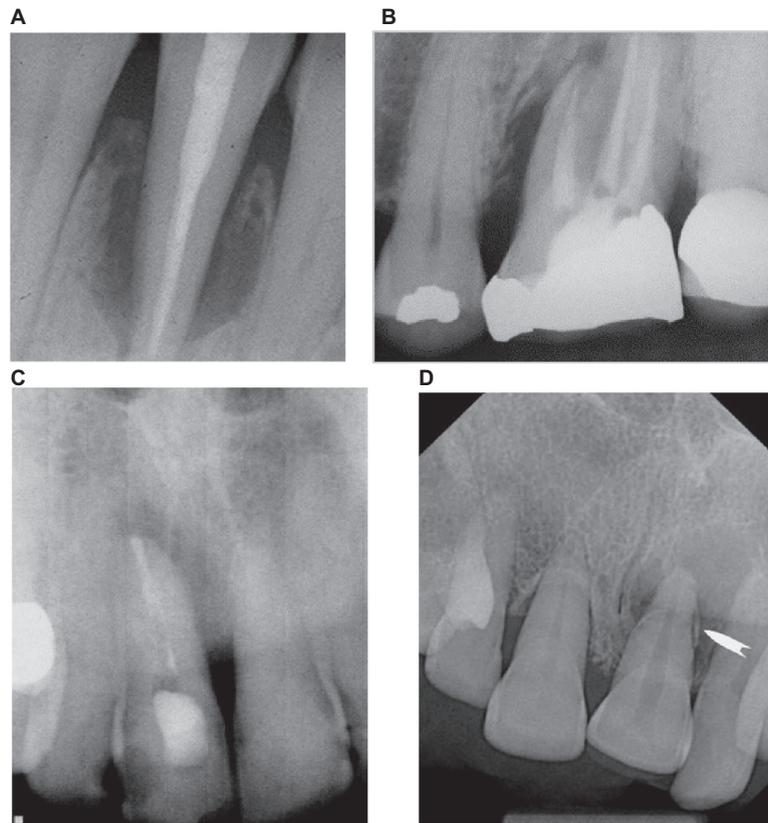


Fig. 1. Examples of the various radiographic presentations of cemental tears. A, Well-demarcated D-shaped along the root, with reverse D-shape on the opposite side of the root (from wrapping around the root), and with loss of lamina dura on the mandibular left central incisor. B, Vertical line on the mesial root, with loss of lamina dura, in this case with extension to the apex on the maxillary left first molar. C, J-shape extending from apex to crestal bone, with loss of lamina dura on the maxillary right central incisor. D, Apical radiolucency with some extension up the root on either side, here with a sliver of cementum visible on the maxillary left central incisor (*arrow*).

tooth.<sup>13,18,23-27</sup> We present the second-largest series of cemental tears published and provide detailed clinicopathologic descriptions.

**MATERIALS AND METHODS**

This was a retrospective review of records and microscopic slides, with all patient demographic characteristics and clinical information derived directly from office records, biopsy request forms, and conversations with contributing surgeons. Cases were selected from the patient pools of the investigators, including a large oral pathology biopsy service receiving tissue from more than 25 states. The study protocol was approved by the institutional review board of the University of Texas Health Science Center, Houston, Texas.

**Inclusion and exclusion criteria**

All cases were derived from surgical exploration of a local, usually painful radiolucency. Inclusion criteria were (1) the preoperative presence of a painful or non-painful radiolucency along a root surface; (2) the associated tooth testing vital via pulp testing or having had

previous endodontic therapy without previous pulp testing (based on communication with the primary care dentists) and with no resolution after the endodontic therapy; (3) biopsy tissue being obtained from paradicular bone at the time of extraction or treatment of the cemental tear; (4) tissue size being adequate for proper processing and histopathologic evaluation; (5) microscopic identification of a detached strip of cementum embedded within or partially covered by fibrovascular stroma not consistent with routine periodontal ligament (PDL); and (6) acceptably detailed clinical, radiographic, and historical information. Exclusion criteria were (1) presence of proven pulpal infection (e.g., periapical abscess, periapical granuloma, or periapical cyst associated with a nonvital tooth); (2) identification of local bone loss and extended probing depths caused by periodontitis; (3) prior diagnosis of a disease with known cementum defects (e.g., cleidocranial dysplasia or hypophosphatemia); (4) a cemental strip removed during extraction with no granulation tissue or non-PDL fibrous tissue attached to the cemental fragment (presumed to represent detachment at the time of extraction); and (5)

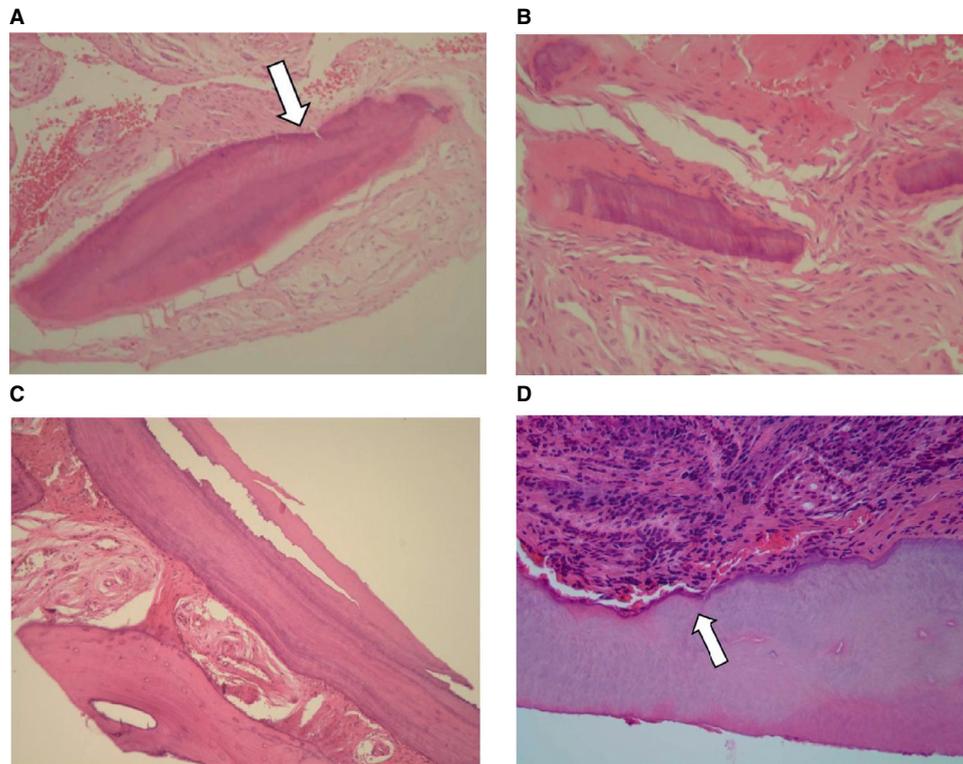


Fig. 2. Cemental tears. A, B, Full-thickness cementum fragments surrounded by fibrous scar tissue, with minimal inflammation and with focal resorption (*arrow*;  $\times 40$  &  $\times 20$ ). C, Cemental fragment still attached to the lamina dura by dense fibrous tissue, from Figure 1D ( $\times 40$ ). D, Cemental fragment with edge facing the root surface covered by fibrous tissue with numerous chronic inflammatory cells, with the entire fragment located outside the area of destroyed lamina dura and with partial resorption (*arrow*), from Figure 1A ( $\times 40$ ).

microscopic appearance of neoplasia or other noninflammatory, nonischemic disease.

### Tissue processing

All biopsy specimens were placed immediately in 10% buffered formalin and submitted to a surgical pathology laboratory, where they were gently decalcified in 5% formic acid for 2 to 6 days and evaluated for softness daily. Once soft enough for further processing, the tissue was cut thicker than normal ( $7\ \mu$ ) to reduce the risk of artifactual blade removal of osteocytes and cementocytes and then stained in the routine fashion with hematoxylin and eosin.

### Histopathology

Light microscopy was used for tissue evaluation. The diagnostic criteria for osseous inflammation and ischemia were taken directly from the orthopedic literature. Inflammatory and ischemic bone diseases, when found, were classified according to the appropriate Bouquot-McMahon microscopic classification system (Table I).<sup>25,26</sup> All specimens were microscopically re-examined by a pathologist (J.E.B.) with extensive training and experience in ischemic and inflammatory

bone diseases, with representative cases also reviewed by the primary author (H.Q).

Specific histopathologic criteria for positive cases included the following:

1. A fragment of cementum was present in the biopsy sample.
2. At least a portion of the fragment was embedded within or attached to granulation tissue, inflamed fibrous tissue, or uninfamed fibrous scar tissue not consistent with normal PDL.
3. Only routine inflammatory cells were present (typically only lymphocytes), without granuloma formation or other unique cellular forms.
4. Tissue fragments showed inflammatory involvement of cancellous, not just cortical (lamina dura) bone.
5. Bone nonviability was not necessary to make the diagnosis.

### RESULTS

Radiographic illustrations of cemental tears are presented in Figure 1. Photomicrographs of the

**Table I.** Bouquot-McMahon classification of inflammatory and ischemic bone diseases<sup>25,26</sup>

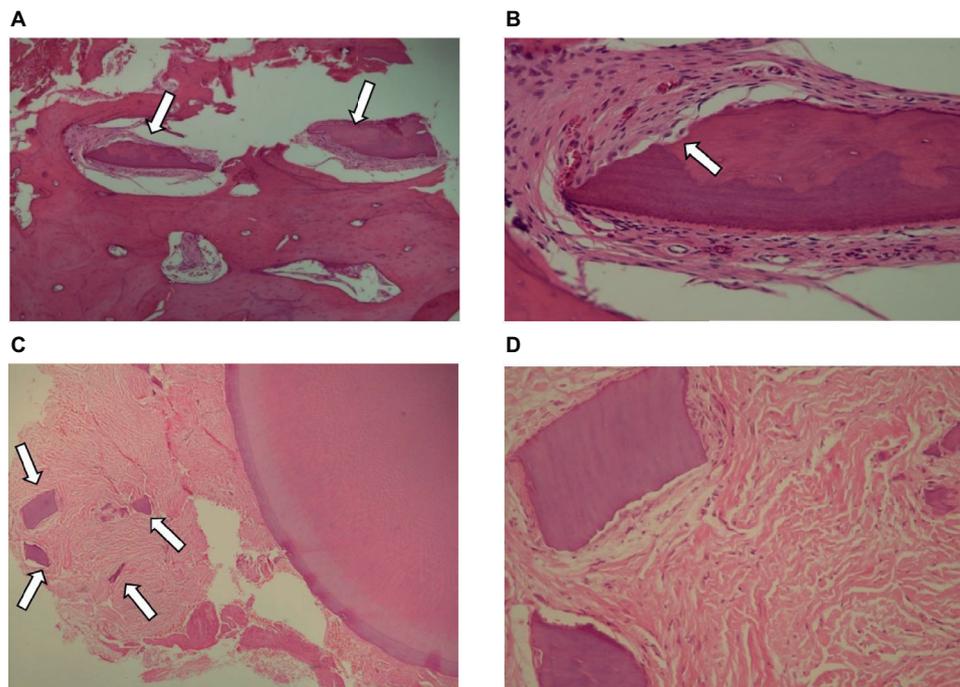
<p><b>Acute osteomyelitis (AO):</b></p> <ul style="list-style-type: none"> <li>• Acute/subacute osteomyelitis, NOS</li> <li>• Actinomycosis</li> <li>• Bisphosphonate-related osteonecrosis of the jaws (BRONJ)</li> <li>• Suppurative periapical granuloma</li> </ul> <p><b>Chronic nonsuppurative osteomyelitis (CNO):</b></p> <ul style="list-style-type: none"> <li>• Chronic nonsuppurative osteomyelitis, NOS</li> <li>• Chronic fibrosing osteomyelitis</li> <li>• Garré osteomyelitis</li> <li>• Chronic granulomatous osteomyelitis                     <ul style="list-style-type: none"> <li>– Intramedullary foreign body reaction</li> <li>– Sarcoid osteomyelitis</li> <li>– Syphilitic/Tubercular osteomyelitis</li> </ul> </li> <li>• Chronic sclerosing osteomyelitis                     <ul style="list-style-type: none"> <li>– Condensing osteitis</li> </ul> </li> <li>• Periapical granuloma, nonsuppurative</li> <li>• Periodontitis (rarely)</li> </ul>	<p><b>Chronic ischemic marrow disease (CIMD):</b></p> <ul style="list-style-type: none"> <li>• Bone marrow edema                     <ul style="list-style-type: none"> <li>○ Ischemic myelofibrosis</li> <li>○ Reticular fatty degeneration</li> <li>○ Marrow congestion (dilated vessels)</li> <li>○ Regional ischemic osteoporosis</li> </ul> </li> <li>• Intramedullary fibrous scar</li> <li>• Ischemic marrow atrophy (honeycombed bone)</li> <li>• Ischemic osseous cavitation                     <ul style="list-style-type: none"> <li>○ Traumatic bone cyst</li> </ul> </li> </ul> <p><b>Chronic ischemic bone disease (CIBD):</b></p> <ul style="list-style-type: none"> <li>• Focally nonviable bone</li> <li>• Bony sequestra (completely nonviable bone)                     <ul style="list-style-type: none"> <li>○ Cortical fragment of Hellstein</li> </ul> </li> <li>• Ischemic osteonecrosis (avascular necrosis)</li> <li>• Ischemic osteosclerosis                     <ul style="list-style-type: none"> <li>○ Bone scar</li> <li>○ Condensing osteitis</li> </ul> </li> <li>• Inhibited (poorly forming) new bone</li> <li>• Focal osteoporotic marrow defect</li> </ul>
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NOS, not otherwise specified.

cemental lesions are presented in [Figure 2](#). Photomicrographs illustrating the fibrous tissue or bone surrounding cemental fragments are depicted in [Figure 3](#). Photomicrographs of the cemental defects and their relation to the teeth are presented in [Figure 4](#).

**Clinical and radiologic features**

Twenty-one cases of cemental tears were identified in 12 men and 9 women (age range 51–91 years; mean age 65.2 years) ([Table II](#)). The most commonly affected teeth were the maxillary incisors (47.6%), especially the central incisors (38.1%), with



**Fig. 3.** Cemental tears in situ. *A*, Two cemental fragments (*arrows*) surrounded by fibrous tissue and partially surrounded by bone (not lamina dura), with minimal chronic inflammation ( $\times 20$ ). *B*, Higher-power view of mild resorption (*arrow*) on the end of one fragment ( $\times 100$ ). *C*, Dense, avascular fibrous tissue surrounds several fragments of cementum (*arrows*) with no inflammatory response, with the affected tooth (*upper right*) showing intact cementum because tears occurred off the plane of sectioning ( $\times 10$ ). *D*, Higher-power view of cemental fragments in *A* ( $\times 100$ ).

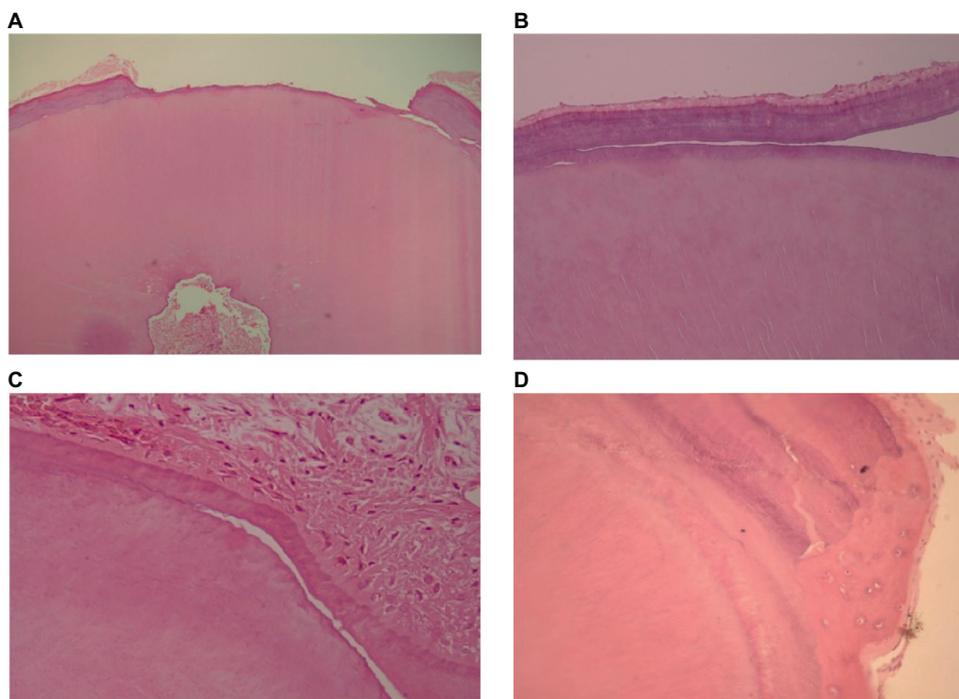


Fig. 4. Extracted teeth with cemental tears. A, Area of torn and removed cementum shows a tear under the remaining cementum with minimal attempted repair (*on right*). B, Large region of cementum is torn away from the root surface adjacent to an area with missing cementum (*top*). C, Endodontically treated tooth with a large area of cementum torn away from dentin (*left*). D, Edge of a region on a root surface where the cemental tear is gone, showing attempted repair.

radiolucencies equally divided between the mesial and distal surfaces. The first and second molars were the next most frequently affected (33.3%), and 3 cuspids (1.4%) showed tears. No third molars or premolars were identified among the cases, except in one case where the surgeon was unsure whether the tear arose from a maxillary first premolar or the adjacent cuspid.

All examples were associated with mild (28.6%) to moderate (71.4%) pain, usually most noticeable during strong occlusal pressure. Only 3 patients (14.3%) showed clinical signs of acute inflammation at the time of the initial examination, each of them presenting with osseous destruction reaching the crestal bone and mimicking periodontal pockets, but did not show deep probing depths. Thirteen teeth without previous endodontic therapy (61.9%) were all vital to thermal pulp testing. Care was taken to communicate with the general practice offices that provided the remaining 8 cases (38.1%) of endodontically treated teeth. All those clinicians admitted to performing endodontic therapy without preoperative pulp testing; all of them had simply presumed that the paradicular radiolucency represented extension of inflammatory pulpal disease. None of the treatments had resulted in resolution of the radiolucency, and none was consistent with a periapical scar histologically. It should be mentioned that many cases of histopathologically identified cemental tears were

excluded from the present study because the initial treating clinician could not or would not admit to treating the tooth without performing preoperative pulp testing.

Twenty radiolucent lesions (95.2%) presented as vertical lesions along the surface of the affected root. The average size of the vertical radiolucencies was 1.1 cm, as measured on periapical radiographs, and the radiolucencies were evenly located on the mesial or distal aspects of the roots. The most common vertical appearance was the D-shaped radiolucency (8 cases [38.1%]), sometimes producing a reversed D-shape on the opposite side of the root as the bone involvement wrapped around the root (see [Figure 1A](#)). Eight lesions (38.1%) presented as thin (5 [23.8%]) or thick (3 [14.3%]) vertical lines (see [Figure 1B](#)), not merely thickened PDLs because all showed loss of bone density in the lamina dura or a linear radiolucency beneath or outside of the lamina dura. Four radiolucencies (19.0%) were J-shaped, with the vertical component combining or fusing with an apical component (see [Figure 1C](#)). One radiolucency (4.8%) was strictly a periapical lesion (see [Figure 1D](#)). There was radiographic evidence of mild external root resorption in 3 cases. All lesions showed focal destruction of the lamina dura, with 14 (66.7%) exhibiting extension into the medullary bone.

**Table II.** Summary of 21 cases of cemental tears identified by radiolucent appearance and confirmed by biopsy, listed by anatomic location

Case No.	Gender	Age (Years)	Location	Pain?	Radiolucency shape, root coverage	Prior RCT?*	Surgically visible shard?*	Bone biopsy diagnosis	
1	F	91	#3	Yes	Thin vertical line, coronal third	No	Yes	IFS	
2	M	61	#5/6	Yes	Thin vertical line, apical third	No	No	CFO	
3	M	65	#8	Yes	J-shaped, entire root	Yes	Yes	CFO	
4	F	66	#7	Yes	Thin vertical line, entire root	No	Yes	CFO	
5	M	79	#8	Yes	D-shaped, apical half	Yes	No	IFS	
6	F	48	#8	Yes	D-shaped, apical half	No	No	CFO	
7	F	53	#8/9	Yes	D-shaped, entire root	No	Yes	CFO	
8	F	87	#9	Yes	D-shaped, entire root	No	Yes	CFO	
9	F	69	#9	Yes	Periapical radiolucency	No	Yes	CFO	
10	M	74	#10	Yes	J-shaped, apical third	Yes	Yes	IFS	
11	M	79	#11	Yes	D-shaped, entire root	No	No	CFO	
12	M	56	#18	Yes	J-shaped, entire root	No	No	CFO	
13	F	80	#19	Yes	Thick vertical line, furcation involved, entire root	Yes	No	CFO	
14	M	59	#14	Yes	D-shaped, entire root	Yes	Yes	CFO	
15	M	55	#22	Yes	Thin vertical line, coronal half	No	No	IFS	
16	M	52	#24	Yes	D-shaped, entire root	Yes	Yes	CFO	
17	F	65	#30	Yes	Thick vertical line, apical third	Yes	Yes	CFO	
18	M	58	#31	Yes	Thick vertical line, furcation involvement, with apical radiolucency	No	No	CFO	
19	M	56	#31	Yes	J-shaped, entire root	No	Yes	CFO	
20	M	51	#9	Yes	D-shaped, apical third	No	No	IFS	
21	F	67	#8	Yes	Thin vertical line, apical third	Yes	No	IFS	
		<b>57.1% males</b>	<b>Avg. age: 65.2 years</b>	<b>Most common: maxillary incisors</b>	<b>100%</b>	<b>8 D-shaped radiolucencies</b>	<b>8 with RCT</b>	<b>8 surgically visible shards</b>	<b>6 IFS, 15 CFO</b>

\*Cemental fragment was seen radiographically or at time of surgery.

CFO, chronic fibrosing osteomyelitis; F, female; IFS, intramedullary fibrous scar; M, male; RCT, root canal treatment.

Two lesions (9.5%) presented primarily as vertical radiolucencies in the furcation area—1 with contiguous apical involvement and 1 with only furcation

involvement; the latter case showed no epithelium and so was not a buccal bifurcation cyst. In total, 3 lesions (14.3%) located toward the coronal portion of the root

were initially thought to represent routine periodontal disease radiographically (see [Figures 1C](#) and [3C](#)). One presented as a radiographically deep periodontal “pseudo-pocket” but with a 3-mm probing depth, whereas the others showed 4-mm probing depths. The PDL was focally thickened in only 5 examples (23.8%).

Cemental fragments were not radiographically apparent in the majority of cases, nor were they identified at the time of surgery. However, vertical radiopaque slivers of cementum were observed in 6 cases (28.6%) (see [Figures 3A–3C](#)), with another 2 slivers identified grossly at the time of surgery. Two examples (9.5%) demonstrated complete “sloughing” of apical cementum in a single bowl-shaped piece (see [Figure 4](#)). In cases showing no radiographically obvious cemental fragments, it was presumed that the tear was not located on a mesial or distal root surface. Cone beam computed tomography imaging would possibly help with the localization of such fragments, but it was available for only 1 of the present cases; this will be reported separately.

### Histopathology

All cases, by definition, included shards of torn cementum (see [Figures 2–4](#)). There was a small layer of dentin attached to a portion of one shard, but otherwise they were composed completely of cementum and appeared to represent the complete layer of cementum—that is, the tear was at the CDJ. A total of 17 shards (81%) showed relatively smooth outlines, with no evidence of attempted resorption, although resorption was evident on the remaining 4 fragments (19.0%) (see [Figures 2A](#) and [2D](#)). Only 3 cases (14.3%) demonstrated torn cementum with obvious PDL attachment. Degenerative fibrous and granulation tissue partially or completely surrounded all fragments of cementum (see [Figures 2](#) and [3](#)).

All bone was viable, with minimal osteoblastic activity and no osteoclastic activity; 2 cemental fragments were partially surrounded by bone (see [Figure 3A](#)). Six tissue samples (28.6%) had regions of such dense, avascular fibrosis with so few inflammatory cells that they obviously represented intramedullary fibrous scar (see [Figures 3C](#) and [3D](#)).<sup>25,27</sup> All others (71.4%) demonstrated medullary spaces filled with relatively loose fibrous and/or granulation tissue, with numerous chronic inflammatory cells, compatible with chronic fibrosing osteomyelitis (CFO)—that is, primary chronic osteomyelitis (see [Figure 3B](#)).<sup>28–30</sup> Acute inflammatory cells were not seen.

Five biopsy samples included the affected teeth. Four of these showed traumatic, focal loss of cementum (see [Figure 4A](#)), and 1 showed complete sloughing of the apical cementum (degloved cementum).

Additionally, 3 of the 5 teeth showed cementum pulled away from dentin at the edge of the missing cementum (see [Figure 4B](#)), and all showed cleaving along the adjacent or distant CDJ. Margins of missing regions of cementum showed minimal attempted repair (see [Figure 4A](#)), but 1 case showed rounding off of cementum at the edge of the defect, without active cementoclasts visible along the hard tissues, suggesting past episodes of resorption (see [Figure 2A](#)). One edge demonstrated bone formation or new cementum formation, but, again, with no apparent osteoblastic/cementoblastic activity at the time of extraction (see [Figure 4D](#)).

All endodontically treated teeth showed a good apical seal, with no residual necrotic pulpal debris and no inflammatory cells in the canals or at the apex.

### Treatment

Seventeen cases were treated with extraction and conservative surgical curettage of the radiolucent area; this included the 8 cases with previous endodontic treatment. Four cases, none with apical radiolucencies, were treated successfully without extraction, via conservative surgical curettage. The bone healed well in all cases, as did the overlying soft tissues, as per short-term follow-up of 3–6 months. One case was without extraction and had been followed for more than 3 years, with “normal” bone radiographically, normal thermal pulp testing results and no evidence of periodontal or mucosal inflammation.

### DISCUSSION

The greatest potential weakness of the present investigation is that we accepted the information given to us by the contributing dental offices; this posed a problem, especially with regard to cases of endodontic treatment of teeth without pulp testing. However, we were very careful to get detailed clinical information from both specialty and primary care offices, and we excluded dozens of cemental tear cases that lacked enough detail so that a high level of assurance of a proper pretreatment diagnosis could be ensured. We believe that this due diligence has been adequate to allow a high degree of confidence in the results. Furthermore, the reader is reminded that as with all case series originating from a biopsy service, we could not ascertain if our sample is truly representative of the general population and how common the lesion is in that population.

The sharp or jagged lateral edges of the cemental fragments in our study samples confirm a traumatic etiology, as has been suggested by virtually every report in the literature. The results additionally confirm that when such fragments remain within or near the PDL, the radiographically visible ones are routinely associated with chronic inflammatory and/or ischemic changes (fibrous scar tissue) that extend to and through

the lamina dura, causing loss of bone density in the underlying medullary bone.

It seems logical, then, to assume that the cemental tear acts merely as an etiologic nidus, whereas the actual disease, producing the local radiolucency and usually nominal pain, is a low-grade, nonsuppurative, chronic inflammation of bone—CFO, also called *primary chronic osteomyelitis*, with or without an associated chronic ischemic bone disease.<sup>29,30</sup> It must be strongly emphasized that this diagnosis implies an indolent, very chronic, anatomically limited, and minimally destructive form of osteomyelitis or chronic ischemic bone disease, characterized by fibrous replacement of bone marrow, small numbers of chronic inflammatory cells, and almost no loss of bone viability. It is not the stereotypical osteomyelitis with pus production, intense pain, and extensive destruction, including cortical perforation.<sup>31,32</sup> The indolent nature of CFO is exemplified by the fact that it is present in at least 16% of asymptomatic edentulous alveolar bone sites.<sup>33</sup> To avoid confusion, we suggest that “cemental tear” should remain the diagnostic term in clinical use.

Approximately one-quarter of our cases showed cemental fragments enveloped by dense, avascular, fibrous scar tissue (see Figure 3C). Such intramedullary fibrous scars are rare bone phenomena. They have never been reported to occur outside of the jaws, except in poorly healed fracture lines. Within the jaws, the periapical scar is a well-known variant, but a series of intramedullary fibrous scars not associated with pulpal infection has been reported only recently, with the suggestion that these scars represent an ischemic effect rather than an inflammatory effect.<sup>28,34</sup>

Presumably, the cemental tear represents an instance in which the connection between the Sharpey fibers and cementum is stronger than the bond between cementum and dentin; it physically pulls a portion of cementum away from the tooth, almost always at the level of the CDJ, and eventually becomes an embedded irritant in the PDL to initiate either a chronic inflammatory or ischemia-related fibrous scar response.<sup>35-37</sup> The CDJ starts embryologically as a fibril-poor layer on the dentin surface and becomes a 1-3 microns thick layer comprised primarily of proteoglycans with mucopolysaccharides, although in its earliest development bone sialoprotein and osteopontin are also present.<sup>35,36,38,39</sup>

Although the intertwining of cementum fibrils with dentin fibrils provides some of the strength at the CDJ, various research manipulations have concluded that the proteoglycans themselves provide most of the attachment strength. Even in maturity, this interface contains significantly fewer collagen fibrils compared with the underlying dentin or the overlying cementum layers, especially in regions of primary (acellular) cementum. This adhesive or “glue” appears to be the root’s

weakest link, explaining why so many cemental tears occur at the CDJ.

All new cemental fibrils attach strongly to the cemental layers as they form, not to the CDJ components. Higher layers, therefore, show increased fibril density and a lesser amount of proteoglycans, with a subsequent increased attachment strength relative to the CDJ. Some cemental tears do, however, occur above the CDJ.<sup>16</sup> Although this does not seem to be a common occurrence, there is an explanation. It is well known that human cementum becomes thicker over time, especially the secondary or cellular cementum in the apical region. However, it is less well known that cementum becomes more calcified and embedded fibrils become weaker with age or that cementum is layered intermittently as a person ages, forming concentric rings of different densities and fiber content.<sup>39</sup>

This ring formation, known as *cemental annulation*, is used to estimate age in mammals; the rings, which can be counted in a fashion similar to counting tree rings, begin to develop before eruption and occlusal contact.<sup>39-42</sup> Less calcified layers of cementum and layers of diminished fibril content or orientation between the cemental rings would appear to be sites susceptible to tearing under excessive occlusal pressures.

On a final note, appropriate pulp testing and periodontal probing remain key diagnostic procedures for

**Table III.** Differential diagnostic listing of entities likely to present as vertical radiolucencies near the roots of teeth, listed alphabetically

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Botryoid (periodontal) cyst*
Buccal bifurcation cyst
Carcinoma, metastatic
Cemental tear
Cracked tooth/root (syndrome)
Floating teeth†
Focal osteoporotic marrow defect
Gingival cyst of adult
Globulomaxillary cyst
Internal/external resorption
Intramedullary fibrous scar
Jaw fracture
Lateral radicular cyst/granuloma
Nasopalatine duct cyst
Nutrient canal, enlarged or dilated
Periodontal pocket
Periodontitis, localized
Residual (ghost) socket
Sarcoma, primary in bone
Vertical root groove, inflamed

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*Note:* This list excludes disorders that present only with thickened periodontal ligament.

\*Routine lateral periodontal cyst is centered in medullary bone, between roots; it erodes lamina dura from the medullary side.

†For example, Langerhans cell histiocytosis, cyclic neutropenia, and Papillon-Lefèvre syndrome.

the evaluation of potential cemental tears, but even with proven pulp viability and normal probing depths (providing strong suspicion of a tear), it is important to confirm the diagnosis via biopsy because several other diseases can produce vertical or apical radiolucencies without pulpal inflammation, some with serious consequences (Table III). Treatment and outcomes based on a correct diagnosis have been extensively discussed by Lin et al.<sup>16,20</sup> For cemental tears near the crestal bone, aggressive scaling and root planing are appropriate, provided the instruments break through the crevicular attachment to plane deeply enough. For more apically located lesions, conservative curettage with or without graft material placement has shown promise. Follow-up has demonstrated, at least in a few cases, that such treatments can preserve the tooth and avoid extraction.<sup>13,18,23-27</sup>

## CONCLUSIONS

The cemental tear appears primarily to be a traumatically induced defect at the CDJ, made susceptible by a developmental or otherwise unexplained weakness of the CDJ. Its surrounding tissue responses presumably result from chronic irritation as the fragment of cementum moves in the PDL during chewing, resulting in quite limited, localized periodontal inflammation. It is important for the clinician to be aware of this to ensure that appropriate treatment can be provided. Additionally, a proper understanding of the limitations caused by the disease is important. To avoid overtreatment, we suggest not changing the diagnostic term from “cemental tear” to “chronic osteomyelitis,” even though the latter is a more histopathologically appropriate term.

It is important to consider cemental tear in the differential diagnosis of any vertical radiolucency adjacent to a root surface, especially when periodontal probing is negative, pulp testing proves the associated tooth or teeth to be vital, and the lamina dura is destroyed. Thus, improper diagnosis of such cases as endodontic or periodontal infections and resorting to extraction as the standard treatment, as it is often today, can be avoided. Local, conservative curettage appears to be a much more appropriate treatment.

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