A study of periapical lesions correlating the presence of a radiopaque lamina with histological findings

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Objective. To compare the presence or absence of a radiopaque lamina of 60 human periapical lesions with the histological findings from a case study in dental practice.

Study design. Paralleling radiographs were taken of 60 teeth with periapical radiolucencies. The periapical radiographs were scanned, and standardized images were evaluated on a computer screen for the presence or absence of a radiopaque lamina by 2 calibrated observers according to agreed criteria. The serially sectioned histological specimens were obtained from the extraction of 13 endodontically treated teeth and 27 nontreated teeth, as well as 20 post-treatment teeth with apical periodontitis removed during periapical surgical procedure; the specimens were classified according to agreed criteria. The findings of the 2 evaluations were compared.

Results. Out of 57 electronic images that could be interpreted, 10 lesions had a radiopaque lamina, but of these only 3 were histologically diagnosed as cysts, while 7 were granulomas or abscesses. Out of 47 lesions without a radiopaque lamina, 40 were histologically diagnosed as granulomas or abscesses, while 7 were cysts.

Conclusions. The diagnosis of periapical lesions cannot be made on the basis of the presence or absence of a radiopaque lamina, but requires histological examination of serial sections.


Apical periodontitis is inflammation and destruction of periradicular tissues caused by etiological agents of endodontic origin, most frequently bacteria; the subject has recently been reviewed.1 Radicular cysts have been a source of debate for many years. A general agreement exists on the assumption that periapical cysts evolve from chronic apical periodontitis. The reported incidence of cysts among lesions of apical periodontitis varies from 6% to 55%;2 however, when serial sectioning or step-serial sectioning has been used3,4 instead of random sections,5,6 52% of the lesions were found to be epithelialized, but only 15% were actually periapical cysts. Some radicular cysts contain cavities completely enclosed by epithelial lining, while others contain epithelium-lined cavities that are open to the root canals.4,7 There have been reports in the literature over the years of attempts to make a differential diagnosis between cyst and granuloma based on their radiological features; a cystic image would exhibit defined margins with a hyperostotic border, whereas the granuloma would show indistinct margins.8 Also, cysts have been stated to have a clearly defined periapical radiolucency that was approximately circular, a loss of the lamina dura at the apex, and most importantly, a thin radiopaque lamina to the lesion.9 Earlier reports were even more definite: cysts were considered to be larger than granulomas,10 and if the lesion were more than 1.5 cm in diameter it would certainly be a cyst.11 These reports have contributed to the notion that those periapical lesions of appreciable size and sharp margins are cysts and must be treated surgically, and the debate continues.12

The purpose of this study was to compare the presence or absence of a radiopaque lamina of 60 human periapical lesions with the histological findings from a case study in dental practice.

MATERIALS AND METHODS

Paralleling radiographs were taken of 60 teeth with periapical radiolucencies by using a film holder (Rinn Corporation, Elgin, IL). The periapical radiographs were scanned, and standardized digital images were stored in a computer before being evaluated on a computer screen (13 inch) according to agreed criteria by 2 trained observers, who were calibrated against reference images. They recorded the presence or absence of a radiopaque lamina on periapical lesions. The observers also viewed 22 of the radiographic films under conditions of standardized magnification and illumination by means of a radiographic viewer (Dental Röntgen, Malmö, Sweden). The radiological examination was performed blind to the results of the histological evaluation.
The patients gave emphasis-placed consent for examination of their teeth. The specimens for histological examination were obtained from the extraction of 13 endodontically treated teeth and 27 nontreated teeth, as well as 20 post-treatment teeth with apical periodontitis removed during periapical surgical procedure. All lesions were attached to an associated root. The specimens were immediately immersed in 10% buffered formalin for at least 48 hours. Demineralization followed in a solution of 22.5% (vol/vol) formic acid and 10% (wt/vol) sodium citrate for a period of 3 to 4 weeks under constant agitation (Lipshaw bone decalculator, Lipshaw Manufacturing Company, Detroit, MI). The endpoint was controlled radiographically. After rinsing for 24 to 48 hours in running water, the specimens were dehydrated and processed for routine histological examination. The specimen was embedded in toto and oriented parallel to the long axis of the main root canal in the apical third of the root, in order to obtain sections with root canal and periapical tissue in direct continuity. Serial sections (150-600) were taken with the microtome set at 4 to 5 µm until the whole specimen was cut. Every fourth slide was stained with hematoxylin and eosin. Selected slides were stained with Masson trichrome to identify collagen, and with Taylor modified Brown-Brenn stain for the presence of bacteria.

The following were considered in the histological examination: (1) the presence and distribution of acute and chronic inflammatory cells, (2) the presence of empty spaces or spaces containing semi-solid material surrounded by epithelium, (3) the presence of cholesterol clefts, (4) a relationship between epithelium and the root, and (5) a relationship between the cystic cavity and the foramen.

The specimens were classified, according to agreed criteria, as periapical abscess, granuloma, or cyst (true or pocket). The findings of the radiological and histological evaluations were compared.

RESULTS

There was agreement between the interpretation of actual radiographs and electronic radiological images in 20 cases, but in the other 2 there was disagreement: one had a lamina present and one did not. The 91% agreement implied that electronic images could be examined reliably. Three electronic images could not be interpreted as the root apex and extent of the lesion were not visible on the image. Out of 57 remaining electronic images, 10 lesions had a radiopaque lamina and 47 did not.

Histological evaluation of these 57 cases revealed 10 cysts, 5 of which were true cysts and 5 were pocket cysts. A total of 35 granulomas and 12 abscesses were observed. All the cysts, except one, were found within granulomatous tissue and classified as cysts; their diameters did not exceed half of the diameter of the entire lesion (Figs. 1 and 2). In only 1 case did the cyst cavity occupy approximately four fifths of the whole lesion; its lumen was entirely filled by cholesterol clefts and bordered by a stratified squamous epithelium. Severe chronic inflammation was present adjacent to the epithelium, which more externally shifted to a connective tissue with few scattered chronic inflammatory cells.

When the radiological evaluation was compared with the histological evaluation, it was found that of the 10 lesions with a radiopaque lamina, only 3 were histologically diagnosed as cysts, while 7 were granulomas or abscesses (5 granulomas, 2 abscesses) (Fig. 3). Out of 47 lesions without a radiopaque lamina, 40 were histologically diagnosed as granulomas or abscesses (30 granulomas, 10 abscesses), while 7 were cysts.

DISCUSSION

The radiological interpretation of periapical lesions is regarded as an inexact process, and therefore, standardization of the process is necessary. For this reason, 2 experienced endodontists examined images jointly, with reference images available. The use of computer images provided magnification and standardized viewing conditions. When the evaluation of 22 images was compared with that of the same 22 randomly viewed radiographs, there was more than 90% agreement.

The histological evaluation of serial sections is a thorough way of ensuring that the presence of strands of epithelium is not confused with the presence of cysts, and that a small cyst in a large lesion is not missed.

The histological evaluation reported an 18% prevalence of cysts, which is similar to those of other studies. This implies that the present sample of periapical lesions is representative. No correlation was found between the radiological diagnosis of a cystic lesion as defined in this study and the histological diagnosis of a cyst. There was a weak trend that cysts were more likely to be found in the group with a radiopaque lamina to the lesion than those without, but overall cysts were in the minority in each group. There appear to be few other studies that have compared radiological and histological evaluations; all these used enhanced radiological techniques to examine lesion density. Two studies had small numbers of lesions, and therefore, their conclusion of a correlation between radiology and histology must be taken with caution. In contrast, the other study had a larger sample size and concluded that there was no correlation. The lack of correlation found in the present study and that by White et al., although examining slightly different radiological aspects, is not surprising given the etiology of periapical cysts.
Fig. 1. **A**, The radiolucent area adjacent to this lateral incisor was assessed as having a radiopaque lamina. **B**, In this section, a small cyst cavity is present close to the apex, and a second cavity (a continuation of the same cavity from other sections) appears deeper in the body of the lesion (hematoxylin and eosin, original magnification ×25). **C**, In this section, far away from the section shown in **B**, the largest diameter of the cyst cavity is visible. It occupies only one third of the periapical tissue (hematoxylin and eosin, original magnification ×25).
Fig. 2.  A, The periapical lesion at the palatal root apex of this maxillary first molar was assessed as noncorticated. B, C, Histological examination shows that this was a cyst; again, the cyst does not occupy the entire lesion. (hematoxylin and eosin, original magnification ×25 and ×50).
Fig. 3. **A**, Maxillary lateral incisor with a corticated radiolucency. **B, C**, Histology shows this was an abscess; microcavities surrounded by severe concentration of acute and chronic inflammatory cells (hematoxylin and eosin, original magnification ×25 and ×1000).
These findings provide evidence to refute statements in the literature that periapical cysts can be diagnosed radiologically.\textsuperscript{8-11} They also provide evidence to support statements in textbooks that there is no correlation between the radiological appearance and histological findings.\textsuperscript{18,19}

**CONCLUSIONS**

No correlation existed between the presence of a radiopaque lamina and the histological diagnosis of cyst. The generic term “periapical radiolucent lesion” should be used rather than “granuloma” or “cyst” when examining radiographs. The differential diagnosis of periapical lesions cannot be made based on radiological appearance, but requires histological examination of serial sections.

**REFERENCES**


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