

Prevalence of Ciliated Epithelium in Apical Periodontitis Lesions

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Abstract

Introduction: This article reports on the morphologic features and the frequency of ciliated epithelium in apical cysts and discusses its origin. **Methods:** The study material consisted of 167 human apical periodontitis lesions obtained consecutively from patients presenting for treatment during a period of 12 years in a dental practice operated by one of the authors. All of the lesions were obtained still attached to the root apices of teeth with untreated (93 lesions) or treated canals (74 lesions). The former were obtained by extraction and the latter by extraction or apical surgery. Specimens were processed for histopathologic and histobacteriologic analyses. Lesions were classified, and the type of epithelium, if present, was recorded. **Results:** Of the lesions analyzed, 49 (29%) were diagnosed as cysts. Of these, 26 (53%) were found in untreated teeth, and 23 (47%) related to root canal-treated teeth. Ciliated columnar epithelium was observed partially or completely lining the cyst wall in 4 cysts, and all of them occurred in untreated maxillary molars. Three of these lesions were categorized as pocket cysts, and the other was a true cyst. **Conclusions:** Ciliated columnar epithelium-lined cysts corresponded to approximately 2% of the apical periodontitis lesions and 8% of the cysts of endodontic origin in the population studied. This epithelium is highly likely to have a sinus origin in the majority of cases. However, the possibility of prosoplasia or upgraded differentiation into ciliated epithelium from the typical cystic lining squamous epithelium may also be considered. (*J Endod* 2014;40:476–483)

Key Words

Apical cyst, apical periodontitis lesion, ciliated epithelium, metaplasia, prosoplasia

The epithelium that normally lines the cavities of apical cysts is classified as stratified squamous epithelium. In some cases, apical cyst cavities can be partially or totally lined by an epithelium that displays the features of the epithelium covering the respiratory airways, that is, a ciliated pluriserial (or pseudostratified) columnar epithelium (1–5). The term *pseudostratified* indicates an epithelium consisting of a single layer of cells of varying height and disposition, all resting on the basal membrane but only some of which reach the free surface. The nuclei are found at different heights with respect to the basal membrane, and after a superficial observation, it seems that the epithelium is stratified. In fact, with appropriate sections and staining, it becomes evident that it is composed of a single layer of cells. Differently, for the ciliated simple columnar epithelium type, present in the mucosa of the fallopian tubes and of the uterus, this variable height of the cells or their nuclei is not observed. The salient feature of both these epithelium types is the presence of cilia. The cilia are moving filament structures with a complex internal organization adapted to contractility, which cover the free surface of the cell. In the respiratory system by moving regularly and rhythmically in the same direction, the cilia serve the purpose of inducing currents in the fluid that bathes the cell surfaces, thereby facilitating the elimination of mucus and solid particles harmful to the organism. The cilia are thin filaments wrapped up by eversions of the plasma membrane. They have a length of 5–10 μm and a diameter of approximately 0.2 μm , which make them visible only at the highest magnifications allowed by the light microscope.

Another feature of the respiratory epithelium is the presence of the goblet cell. This cell, which can be defined as the only example of single-cell gland in the human body, finds itself inserted between the epithelial cells. Its main function is to secrete mucin, a protein-polysaccharide that, along with water, generates the mucus. During the secretion process, drops of mucinogen accumulate between the nucleus and the free surface of the cell. Consequently, the cell relaxes and assumes a typical cup shape, whereas the nucleus is displaced at the opposite pole. The drops of mucus are lost after common methods of specimen fixation and histologic processing; therefore, the apical portion of the cell displays apparently empty vacuolar areas.

The purpose of this article is to report on the morphologic features and the frequency of ciliated epithelium among apical cysts in humans and to contribute to the discussion on its origin.

Materials and Methods

The study material consisted of 167 human apical periodontitis lesions attached to the root apices of either extracted teeth with untreated canals (93 lesions) or root canal-treated teeth (74 lesions); the latter were obtained by extraction or apical surgery. The teeth were extracted because they were deemed unrestorable, or the patient did not accept further treatments. Apical surgery was performed because of failure of the previous nonsurgical root canal treatment, and particular care was taken to obtain the resected root tip and the surrounding pathologic soft tissue in their original relationship. The root tip was first resected approximately 3 mm short of the apex with a diamond bur cooled by sterile saline solution. Subsequently, the soft tissue was carefully enucleated from the bone crypt with smooth microelevators. All the specimens were collected consecutively in a dental practice operated by one of the authors (D.R.) during a period of 12 years. The patients had a mean age of 40.6 years (range, 16–81 years) and

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provided consent for examination of their teeth and biopsy specimens. Teeth were excluded if there was severe periodontal disease or a longitudinal fracture or crack involving the root. Part of this archive material was the subject of previous analyses (6–10).

The specimens were immediately immersed in 10% buffered formalin for at least 48 hours and processed for histologic and histobacteriologic analyses. Laboratory procedures have been described elsewhere (6–9). Briefly, demineralization was carried out in an aqueous solution consisting of a mixture of 22.5% (vol/vol) formic acid and 10% (wt/vol) sodium citrate for 3 weeks, dehydration in ascending grades of ethanol, clearing in xylene, infiltration, and embedding in paraffin. Longitudinal serial sections were taken with the microtome set at 4–5 μm until the whole specimen was cut. Particular care was taken to obtain sections passing through the main foramen/ina encompassing the apical canal space and the periapical pathologic tissue. Every fourth slide was stained with hematoxylin-eosin. Selected slides were stained with Masson trichrome to identify collagen and epithelium and with the Taylor modified Brown-Brenn stain for the presence of bacteria. Lesions were classified according to the histopathologic conditions, and the type of epithelium, if present, was recorded.

Results

Of the 167 apical periodontitis lesions analyzed, 49 (29%) were classified as cysts (Table 1). Of these, 26 (53%) were found in the group of untreated teeth, and 23 (47%) related to root canal–treated teeth. Ciliated columnar epithelium was observed partially or completely lining the cyst wall in 4 cysts (Table 2), and all of them belonged to the group of teeth with untreated canals. The 4 lesions were associated with maxillary molars (2 with the first, 1 with the second, and 1 with the third molar). On the basis of widely agreed histologic criteria (8, 11, 12), 3 of these lesions were categorized as pocket cysts and 1 as true cyst (Table 2). The following is a detailed description of these 4 cases.

Specimen PE

This cyst was attached to the palatal root of a maxillary first molar of a 25-year-old woman, who reported several abscess episodes associated with this tooth in the past. A panoramic radiograph showed a periapical ill-defined lucency associated with this tooth (Fig. 1A). The lesion was observed only after extraction and presented with an unusual extension at its top (Fig. 1B), revealed by histologic examination to be ciliated columnar epithelium (Fig. 1C and D), probably of maxillary sinus origin. The diagnosis was of pocket cyst, because the cyst cavity was contiguous with the root canal lumen (Fig. 1E). A ciliated columnar epithelium covered approximately three-fourths of the fibrous capsule, whereas the remaining portion was lined by stratified squamous epithelium. The voluminous epithelial cells displayed large nuclei located in the basal pole and distinct cilia placed on the free side, mostly running parallel to the long axis of the cell (Fig. 1G and H). By using Masson trichrome stain, the cell pole that provides attachment to the cilia appeared more intensely stained (Fig. 1G and H). Goblet cells were interspersed with epithelial cells. When visible, their nucleus was flattened at the base of the cell. Their cytoplasm appeared distended by vacuolar spaces and sometimes

TABLE 1. Types of Lesions That Were Observed

Lesion type	Number	Percentage
Abscess (epithelialized and non-epithelialized)	48	28.7
Granuloma (epithelialized and non-epithelialized)	70	41.9
True cyst	22	
Pocket cyst	27	
Total cyst	49	29.4
Total	167	100

seemed open toward the cystic lumen (Fig. 1H). Serial sections did not demonstrate a communication between the cyst cavity and the external surface of the lesion. Sections through the foramen showed resorption of the apical root structure (Fig. 1E). Histobacteriologic staining revealed no bacteria in the cyst lumen. Bacteria were observed in large numbers in apical ramifications and in the apical root canal, forming thick bacterial biofilms adhering to the root canal walls.

Specimen FC

In this case of a 70-year-old woman, the lesion remained adhered to both roots of a 2-rooted maxillary second molar after extraction. The tooth crown was totally destroyed by caries, and the patient reported several abscess episodes, which were treated with antibiotics. The tooth was asymptomatic at the time of extraction. After extraction a large lesion with eccentric “clear area” was evident, clearly demarcated from the remainder of the pathologic tissue. Histologic sections revealed that this clear mass had a pedunculated polyp-like structure with a head and a stalk. This mass was mainly composed of severely inflamed connective tissue, with several microabscesses, and was completely lined by ciliated epithelium. At the base of this structure, the lining epithelium continued toward the body of the lesion. The presence of a cyst became evident in the sections passing at the center of the lesion. Serial sections revealed that the lesion was a pocket cyst. A ciliated pseudostratified columnar epithelium lined the major part of the cyst cavity, whereas in some areas stratified squamous epithelium was found. Polymorphonuclear neutrophils were occasionally observed between the epithelial cells, flattened along their own axis as they passed through the epithelial wall. These defense cells were certainly attracted to the cyst lumen where bacterial cells were present in large numbers colonizing the abundant necrotic debris present. A direct communication between the cyst lumen and the lesion surface was observed in no sections. Large bacterial biofilms were found in the root canals, layering the walls and colonizing dentinal tubules.

Specimen UA

This cyst was attached to the mesiobuccal root of the maxillary right first molar from a 45-year-old woman. The patient reported that the tooth had been restored approximately 5 years previously and that the restoration was lost 1 year before. There had been episodes of severe spontaneous pain in the past, which were localized to the

TABLE 2. Clinical Data of Specimens

Specimen	Tooth no./root	Gender	Age (y)	Histopathology
PE	14/palatal	F	25	Pocket cyst
FC	15/palatal and buccal*	F	70	Pocket cyst
UA	3/mesiobuccal	F	45	Pocket cyst
BC	1/buccal root*	M	48	True cyst

*Molar with only 2 roots (buccal and palatal).

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