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Hamartomatous proliferations of odontogenic epithelium within the jaws: a potential histogenetic source of intraosseous epithelial odontogenic tumors

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BACKGROUND: The jawbone is replete with a vestige of odontogenesis. The overall consensus is that intraosseous remnants of the enamel organ and dental lamina are the only histogenetic option for central epithelial odontogenic tumors. Curiously, incipient tumors or possible precursor conditions of residual odontogenic epithelium have rarely been reported in the literature.

METHODS: We microscopically evaluated 39 660 biopsy samples to determine the presence of a tumor-like odontogenic epithelial nodule in the maxilla and mandible.

RESULTS: Seven intraosseous specimens that associated with a focal proliferation of odontogenic epithelium were retrieved. Six hamartomatous processes showed four different morphologic patterns comparable with the tumor nests comprising ameloblastoma ($n = 1$), squamous odontogenic tumor ($n = 1$), calcifying epithelial odontogenic tumor ($n = 2$) and calcifying cystic odontogenic tumor ($n = 2$). Among six lesions, four were the intrafollicular development. The remaining case of interest was multiple hyperplastic clear rests of Malassez in association with an impacted tooth.

CONCLUSION: Although it is impossible to predict the fate of these microscopic structures of hamartomatous character, the present case series indicates that any of the dormant embryonic residues of odontogenic epithelium can return to an active state, capable of non-reactive, probably neoplastic proliferation of pathological significance.

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Keywords: dental follicle; dental lamina; enamel organ; epithelial remnants; hamartoma; jawbone; rests of Malassez

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Introduction

After the completion of odontogenesis, residual epithelium of tooth-forming apparatus establish residence both in the bone and in soft tissue of the jaws (1–4). These developmental inclusions persist into adult life and are divided into four main types: rests of Malassez in the periodontal ligament (Hertwig's root sheath remnants), rests of dental lamina in the alveolar bone (2), rests of enamel organ deep in the body of jawbone (5–7), and rests of Serres in the gingiva. Such embryonic residues stay dormant for a long period of time but can resume active growth at a later time, resulting in the formation of epithelial odontogenic tumors (1–4). Our group already demonstrated that the gingival rests of Serres possess an inherent potential to give rise to a variety of peripheral odontogenic tumors, continuing throughout life (8). An additional cogent source of central epithelial odontogenic tumors is the pericoronal follicular tissue which houses abortive ameloblastic epithelium because of their common dentigerous relationship to mature unerupted or impacted teeth (1, 2).

The purpose of this article was to describe the pathologic characteristics of seven instances of singular odontogenic epithelial proliferations within the jawbones. Although these microscopic processes do not deserve further histological subclassification, the present unique and often challenging findings are histogenetically significant and worth noting.

Materials and methods

The hematoxylin and eosin-stained slides from the archival files of the Department of Pathology at the Meikai and Tsurumi Universities between 1970 and 2004 were reviewed (8). Clinical data, including radiographic appearance and follow-up, were sought from the medical records. All cases that associated with microscopic foci of proliferating odontogenic epithelium were thoroughly examined through sectioning at many levels, with appropriate special and immunohistochemical stains.

Results

Of 39 660 biopsies reviewed, we retrieved seven intraosseous specimens that contained a tumor-like nodule of odontogenic epithelium. They were chance findings and not removed on suspicion of tumor occurrence. Although a part of lesion was left at the surgical margins in all cases, neither regrowth nor recurrence has been recorded, with a follow-up period of 4 months to 120 months (mean 48 months). As these microscopic conditions obviously lacked the neoplastic quality, we included them in the range of hamartomas (8). Two intrafollicular soft masses associated with supernumerary teeth could be, in a broad sense, categorized into the spectrum of lesions known as the developing odontomas (2); however, because of their peculiar histologic findings, they are described in this study.

Ameloblastoma-like lesion

A 9-year-old boy had an impacted supernumerary tooth in the palatal aspect of an upper left central incisor. A well-formed 6-mm tooth and the surrounding soft tissue were submitted for microscopic evaluation. Within the collagenous sac was a 1.5-mm nodule of ameloblastic epithelium (Fig. 1a). Palisaded columnar basal cells showed diagnostic features for early ameloblastoma including hyperchromatism and reverse polarization of nuclei and subnuclear vacuolization. Central to the ameloblast-like cells, areas reminiscent of the stellate reticulum could be identified (Fig. 1b). There was no stroma of dental papilla-like immature ectomesenchyme. At a microscopic level, distinguishing this lesion from small ameloblastoma was difficult (Fig. 1c,d).

Squamous odontogenic tumor (SOT)-like lesion

A 47-year-old man related a localized loosening of a vital lower left second premolar. Radiographs showed a cup-shaped bone loss of the alveolar crest (Fig. 2a). A microscopic finding of note was a focal proliferation of benign odontogenic epithelium, usually two cell layers thick, along the lateral root surface of a removed tooth (Fig. 2b). The lesion eroded the crestal bone (Fig. 2c), but did not extend beyond the apical third of the root. The double strands of bland epithelial cells were basaloid in appearance and markedly similar to the cord-like rests of Malassez. They were positive for pancytokeratin (AE1/AE3, DakoCytomation, Carpinteria, CA, USA, 1:50; Fig. 2d). A mild chronic inflammatory infiltrate was evident in the fibrous stroma.

Calcifying epithelial odontogenic tumor (CEOT)-like lesion

Case 1. A 14-year-old boy was admitted with a 5-mm pericoronal radiolucency of a horizontally impacted lower right second molar. At operation, the tooth crown was invested by thickened sac and cystic structure could not be verified. Histologically, the myxofibrous follicle contained anastomosing sheets of squamoid epithelium (Fig. 3a,b). Within the epithelial nests were Liesegang ring-type calcifications (Fig. 3c) and Congo red-positive materials (Fig. 3d). In many areas, CEOT-like foci were

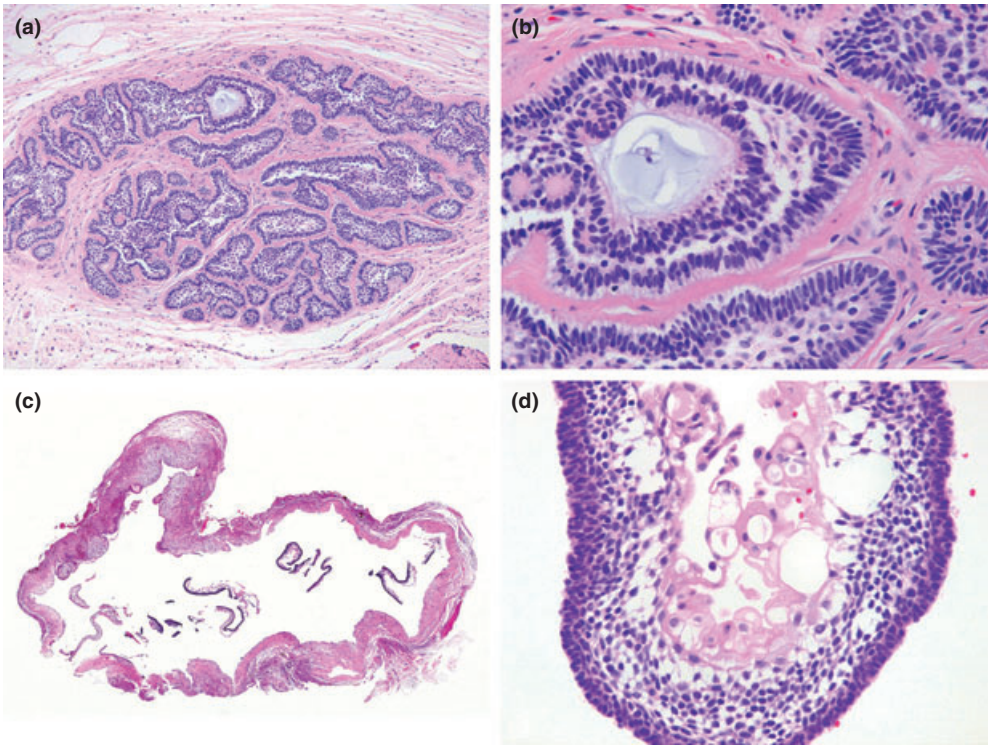

Figure 1 (a, b) Epithelial mass resembling follicular ameloblastoma (H&E, a, ×100; b, ×400). (c, d) A 9-mm cystic ameloblastoma of the alveolar crest between lower left premolars in a 43-year-old man (H&E, c ×10; d ×400).

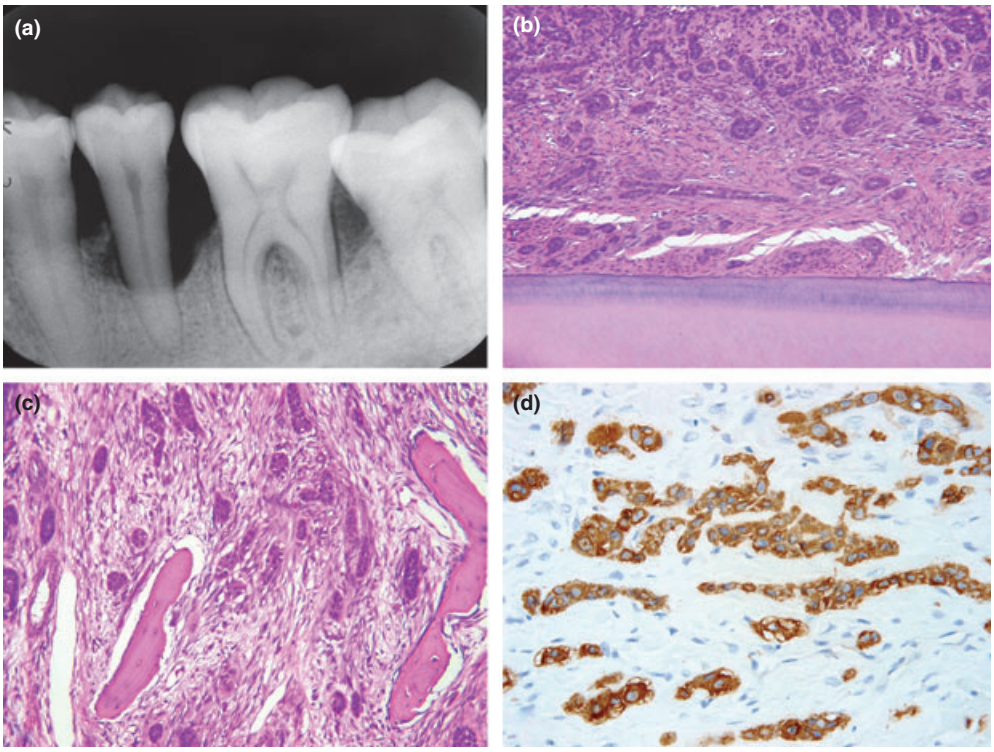

Figure 2 (a) Superficial bone loss of the alveolar crest. (b, c) Proliferation of bilayered rests of Malassez and residual bone (H&E, b ×200; c ×400). (d) AE1/AE3 reactivity (ABC method, ×400).

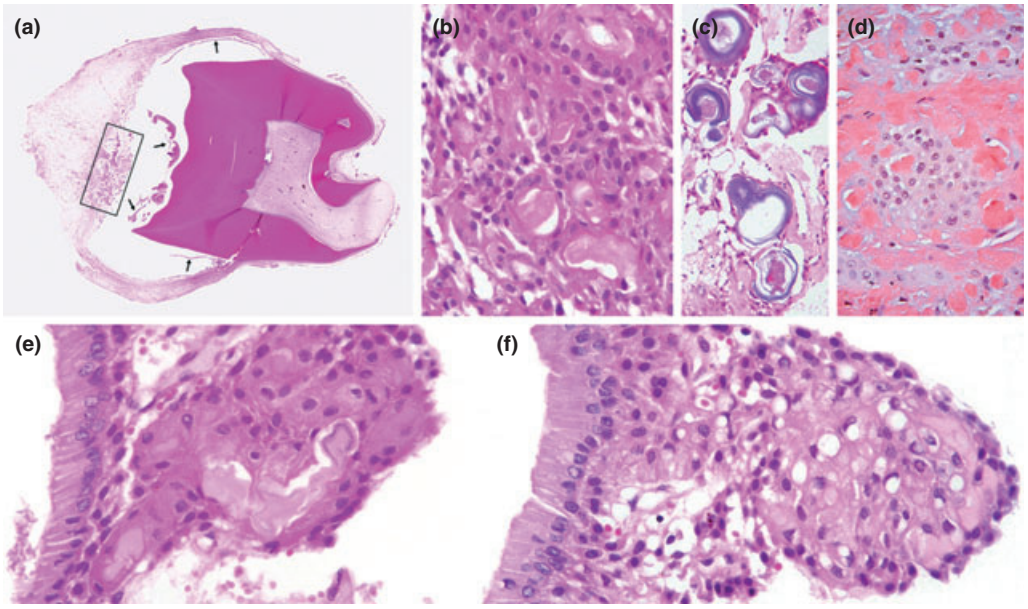

Figure 3 (a) Calcifying epithelial odontogenic tumor (CEOT)-like focus (rectangle) and reduced enamel epithelium (arrows) (H&E, ×5). (b) Squamoid epithelium (H&E, ×400). (c) Liesegang ring-type calcification (H&E, ×200). (d) Amyloid-like material (Congo-red, ×400). (e, f) CEOT-like phenotype of the stratum intermedium (H&E, ×400).

seen in direct continuity with the reduced enamel epithelium (Fig. 3a,e,f).

Case 2. The patient was a 16-year-old man who had a retained lower left deciduous canine. Radiographs revealed a small supernumerary tooth and an apparently normal permanent canine embedded just below the apex of a retained tooth. Microscopically, an ill-organized tooth-like structure enveloped by the fibrous sac consisted of enamel matrix, tubular dentin and dentinoid. There were CEOT-type epithelial sheets among the hard

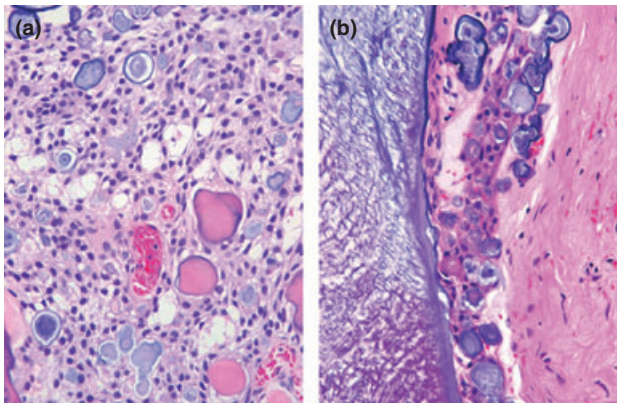

Figure 4 (a) Calcifying epithelial odontogenic tumor (CEOT)-type epithelial sheet (H&E, ×400). (b) CEOT-like change in the reduced enamel epithelium (H&E, ×400).

tissues (Fig. 4a). Liesegang ring-type calcifications were often seen in association with the reduced enamel epithelium (Fig. 4b). Cong-red stain was focally positive in CEOT-like foci.

Calcifying cystic odontogenic tumor (CCOT)-like lesion

Case 1. An 11-year-old boy presented with a pericoronal mixed radiolucent/radiopaque lesion of an unerupted upper right lateral incisor (Fig. 5a). The enlarged follicle was excised and the crown was surgically exposed. Histological examination revealed multiple large solid nests of basaloid epithelium within a hemosiderin-deposited fibrous sac (Fig. 5b). A 1.5-mm radiopaque mass surrounded by thick capsule was composed exclusively of ghost cells exhibiting calcification (Fig. 5c). The dental hard tissue was less evident (Fig. 5d). AE1/AE3 highlighted basaloid and ameloblastic epithelium but not ghost cells.

Case 2. A 6-year-old boy had a 6-mm soft nodule of 1 year duration on the palatal gingiva of an upper right deciduous incisor. Compared with the adjacent deciduous incisors, this tooth was markedly mobile. At operation, the bulk of the lesion was found as an intrabony mass in the alveolar crest and an erupting permanent incisor appeared uninvolved. Microscopically, a solid mass was attached to the root of a shedding tooth (Fig. 6a). Deep in the fibrous tissue was a nonencapsulated conglomerate of dentinoid, ghost cells and ameloblastic epithelium (Fig. 6b). Often, ghost cells were surrounded by a foreign body giant cell reaction (Fig. 6c).

Hyperplastic clear cell rests of malassez

The patient was a 54-year-old man who had a completely impacted lower right third molar. Histologically, multiple large rounded islands of the clear epithelium were present in the periodontal ligament of a removed tooth (Fig. 7a). Some of them had an appearance reminiscent of sebaceous cells (Fig. 7b). Neither peripheral palisading nor stellate reticulum was evident (Fig. 7c). Periodic acid-Schiff positive, diastase-labile fine granules were contained in many of clear cells. The hyperplastic clear cell nests showed some cytologic resemblance to the so-called clear cell tumor (Fig. 7d,e). There was no inflammatory infiltration. Postoperative examination ruled out the possibility of metastatic disease.

Discussion

The jawbone is host to epithelial odontogenic tumors (1–4). Considering that almost all types of incipient or early tumors have been observed (7, 9, 10), it is theoretically acceptable that *in situ* or precursor epithelial lesions may exist, either separately or adjacent to tumors. However, previous descriptions of microscopic tumor-like alterations of intraosseous odontogenic epithelial remnants are exceptional (5, 7, 9). This disparity could be explained in part by the possibility that such fortuitous discoveries are of academic and research interest only and overlooked during routine tissue diagnosis. Recently, Bouquot et al. (7) found 84 rests and five incipient tumors of odontogenic epithelium outside the periodontal ligament space in 5034 jawbone biopsies. The latter subclinical lesions included one ameloblastoma, two SOT and two CEOT. Unfortunately, it is difficult to compare their latent tumors with our hamartomas because of the lack of detailed data (7).

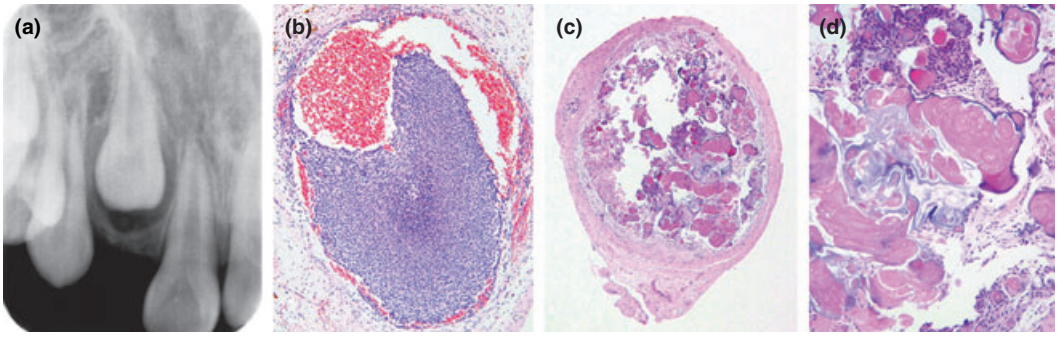

Figure 5 (a) Small radiopaque masses within a pericoronal radiolucent lesion. (b) Basaloid epithelial island (H&E, ×200). (c, d) Calcified ghost cells (H&E, c ×40; d ×400).

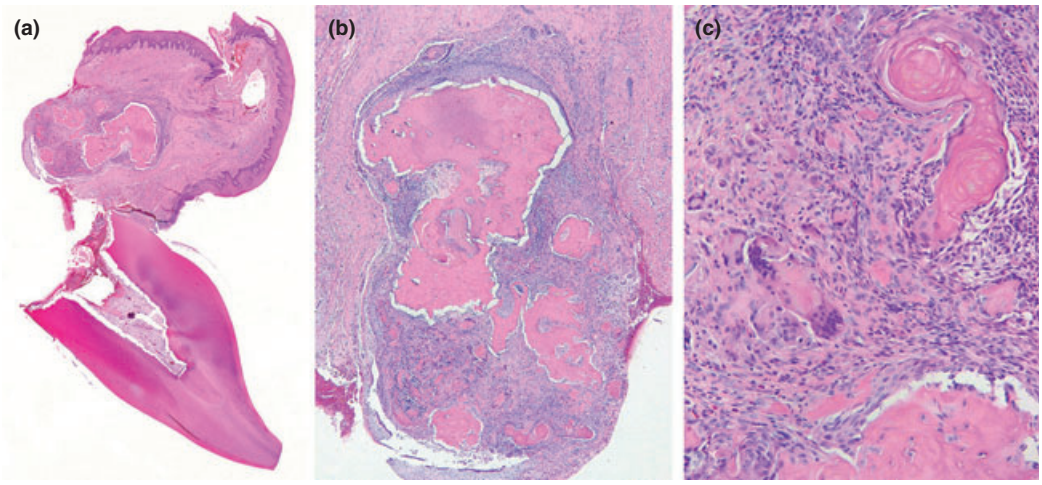

Figure 6 (a) Solid tumor attached to a shedding deciduous tooth (H&E, ×8). (b) Mass of dentinoid, ghost cells, and ameloblastic epithelium (H&E, ×100). (c) Foreign body reaction (H&E, ×400).

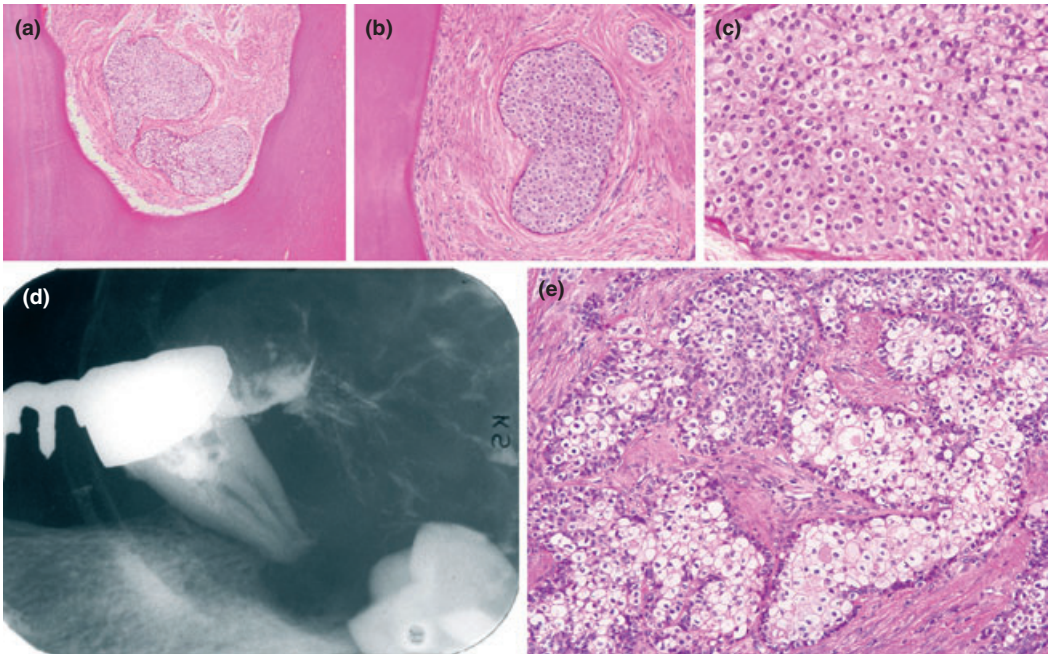

Figure 7 (a) Two larger clear rests of Malassez (H&E, ×40). (b) Sebaceous-like appearance (H&E, ×200). (c) Cells with clear or granular cytoplasm (H&E, ×400). (d, e) Clear cell odontogenic carcinoma of the lower left mandible in a 55-year-old man (H&E, e ×200).

Ameloblastoma-like lesion

The present intrafollicular epithelial mass exhibited features analogous in structure to follicular ameloblastoma (1, 2, 11). However, because of small quality, this microscopic ameloblastoma-like lesion provides a diagnostic dilemma. It is interesting that unsuspected small ameloblastomas have been reported in the interradicular (12–14), periapical (15, 16), paradental (17) and pericoronal (10, 18, 19) settings. Moreover, ameloblastomatous changes of intraosseous odontogenic epithelial residues, although uncommon (20, 21), have incidentally been discovered in the body of jaw (5, 22), interdental alveolar crest (9), periodontal ligament (23), dental follicle (24) and cyst wall (25). These observations indicate that all types of epithelial rests can produce ameloblastomas (1–4). It must be borne in mind, however, that the maxillary incisor region in our patient is an unusual site for conventional ameloblastoma (26, 27). From the practical standpoint, one such rest, or even a few, does not justify the diagnosis of ameloblastoma (11), but this information should be noted in the pathology report.

SOT-like lesion

Squamous odontogenic tumor is a hamartomatous proliferation of rests of Malassez in the periodontal

ligament (1, 2, 4). Dental lamina may also be the potential source for rare cases in association with the crown of unerupted or impacted teeth (28). To our knowledge, a developing SOT is composed primarily of rounded or angular shaped islands of well-differentiated squamous epithelium and not of double-stranded basaloid epithelial rests (29, 30). If the present small lesion is in an immature stage of tumor evolution, primitive epithelial islands with probable origin from the rests of Malassez would be expected to enlarge and mature to take on the characteristics of SOT (1, 2, 4). It remains uncertain whether chronic mild periodontitis in our patient is the cause of, a contributor to, or an incidental juxtaposition regarding the occurrence of SOT-like lesion. Diagnostic consideration must also be given to central odontogenic fibroma, epithelium-rich type (2, 3, 31); however, the mature collagenous stroma in this case was not an integral mesenchymal component.

CEOT-like lesion

The sheets of squamoid epithelium, amyloid-like materials and Liesegang ring-type calcifications all help distinguish our pericoronal lesions from ordinary calcified follicular tissues (20, 21, 32). There were a few reports of intrafollicular (33, 34) and perifollicular (10) tumors with features of CEOT. Considering a fairly common association of CEOT with an impacted tooth (1, 2, 35), there may be a logical sequence of such incipient lesions progressing to destructive tumors. As shown in the present cases and other reports (34, 35), CEOT-type epithelium were seen in direct contact with, and in apparent transition from, the stratum intermedium of the reduced enamel organ. This finding supports that CEOT associated with the crown of impacted teeth may have an origin from the reduced enamel epithelium (1, 2).

CCOT-like lesion

Ghost cells typify the so-called calcifying odontogenic cyst that has now been designated as CCOT (3). Our cases differ from conventional CCOT in two respects; location and size. Although CCOT exhibits a wide variety of clinical features (1, 2), it would not be expected to localize in the perifollicular space or the superficial alveolar crest. Both lesions were quite small and showed very limited or no intrinsic potential for persistent growth. As demonstrated in case 2, a small intrabony CCOT in a child may facilitate its eruption in the same way as an eruption cyst. In consideration with the report that peripheral CCOT is a lesion of adult with a mean age of 63.5 years (36), several peripheral examples in pediatric patients may represent the gingival manifestation of central CCOT following tooth eruption and not a true soft-tissue process (37, 38).

Hyperplastic clear cell rests of Malassez

Not uncommonly, the clear appearance has been recorded in small inactive epithelial islands of dentigerous cyst (39), lateral periodontal cyst (40), opercula (20) and periodontal ligament (23, 41). Of note is that the larger proliferated rests of Malassez averaging eight to 10 times the size of the normal resting type as observed in our case were found in patients over 50 years (5, 23). Unlike conventional small rests, the present hyperplastic clear nests exhibit many overlapping features of neoplastic or pre-neoplastic rests of Malassez in carcinogen-administered rats (42). We are not certain whether clear cell odontogenic carcinoma is thought to be histogenetically related to the periodontal ligament rests of clear cell type (41).

Conclusions

This study further emphasizes the importance of submitting all excised tissues for histologic evaluation. Presumably, the occurrence of microscopically recognizable intraosseous hamartomas of residual odontogenic epithelium may be more frequent than has been reported in the literature (7, 9). As the present epithelial proliferation was present in only a small part of the lesion, there has been considerable debate in deciding how much epithelial element is necessary for such a microscopic mass to be diagnosed as neoplastic (11, 25). Their histogenetic significance warrants further discussion and can be ascertained by compiling larger series of cases.

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