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Original Article

Clinicopathological analysis of 232 radicular cysts of the jawbone in a population of southern Taiwanese patients

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Abstract This retrospective study aimed to evaluate the clinicopathological features of 232 cases of radicular cyst (January 2001–December 2016) submitted for histopathological examination to Department of Oral Pathology by endodontists in our institution. Demographic data including age, gender, affected site, involved tooth, and histopathological features, were reviewed. The study population comprised 133 females (57.3%) and 99 males (42.7%), with a mean age of 40.5 years and an age range of 13–78 years. Two-hundred and one cysts occurred in the maxilla (86.7%) and 31 in the mandible (13.3%). Most cases involved the anterior teeth of the maxilla (67.2%). The most frequently-involved tooth was the maxillary lateral incisor (50.5%). In most cases (228 cases; 98.3%), the cyst was lined with nonkeratinized stratified squamous epithelium, with two cases containing epithelial lining of the mucoepidermoid epithelium (0.9%) and respiratory epithelium (0.9%), respectively. One case (0.4%) revealed epithelial dysplasia of the epithelial lining. Hyaline body was seen in two cases (0.9%), and Rushton body was noted in seven cases (3.0%). Odontogenic epithelial rest was noted in one case (0.4%). Cholesterol clefts (54 cases; 23.3%), foamy histiocytes (72 cases; 31.0%), hemosiderins (57 cases; 24.6%), dystrophic calcifications (94 cases; 40.5%), foreign bodies (44 cases; 19.0%), and bacterial colonies (22 cases; 9.5%) were also observed. Fifty-three cases (22.8%)

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showed a mixed acute and chronic inflammatory infiltrate, whereas chronic inflammatory infiltrate only was noted in 179 cases (77.2%). In summary, the current findings provide a valuable source for clinicopathological reference concerning radicular cysts of the jawbone.

Introduction

Periapical lesions originating from infected pulp are the most common pathologic sequelae of the periapical alveolar bone of the jaw. Although nonendodontic periapical lesions can occur in the periapical alveolar bone [1], the majority of periapical lesions comprise radicular cysts (or periapical cysts), periapical granulomas and apical periodontitis, accounting for approximately 88% and 73% of all periapical lesions according to studies of Becconsall-Ryan et al. [2] and Koivisto et al. [3], respectively.

Most inflammatory periapical lesions are usually treated with root canal therapy in dental clinics initially; however, when symptoms and signs still persist, and complete healing of the periapical alveolar bone fails to occur, surgical curettage or enucleation is employed to remove the pulpo-periapical pathoses. Surgical specimens from periapical lesions are subsequently submitted for histopathological diagnosis [4]. To the best of our knowledge, a comprehensive survey of the clinical and histopathological features of radicular cysts in Taiwanese patients has been limited. Moreover, there exists a greater diversity of histopathological features of radicular cysts as compared with periapical granulomas. Therefore, the current study aimed to retrospectively analyze the clinicopathological characteristics of radicular cysts in a population of southern Taiwanese patients, and to provide updated information regarding radicular cysts and comparisons with previous studies [4–11].

Materials and methods

All cases of radicular cyst in the current study, retrieved from between January 2001 and December 2016, were treated by two experienced certified endodontists of our institution, who performed either curettage or enucleation in all cases in the present study population. Demographic data including the age and gender of the patients, as well as the affected region (maxilla/mandible) and the involved tooth, were recorded. Due to the retrospective nature of the present study, informed consent was waived in accordance with the standards of the Institutional Review Board of Kaohsiung Medical University Hospital (KMUHIRB-E(II)-20150161).

Specimens were fixed in 10% neutral formalin, dehydrated in graded alcohol, and embedded in paraffin. Tissue paraffin blocks were cut into serial sections of a thickness of 4 μm and stained with hematoxylin and eosin. A histopathological diagnosis and an evaluation of the histopathological features were made by two board-certified oral and maxillofacial pathologists.

The histopathological criteria for a radicular cyst were defined as: (1) located in the periapical region of a non-vital tooth without periodontal communication, and (2) a lesion demonstrating a cystic cavity chiefly surrounded by a nonkeratinized stratified squamous epithelial lining, with inflammatory cells in the connective tissue wall [4]. The degree of chronic inflammation was classified as mild when the proportion of the chronic inflammatory cells were less than 25% of the whole tissue; whereas the proportion of chronic inflammatory cells was between 26% and 50%, and more than 50%, it was categorized as moderate and severe, respectively [4].

Results

A total of 232 cases of radicular cyst were histologically analyzed over the 16-year study period. The study population comprised 133 females (57.3%) and 99 males (42.7%), with a mean age of 40.5 years and a relatively wide age range (13–78 years). The lesions were mostly occurred in the 3rd and 5th decades of life (both with 57 cases; 24.6%) contributed for nearly 50% of the total number of cases, followed by the 4th decade (43 cases; 18.5%), and the 6th decade (33 cases; 14.2%). Of the 232 cases of radicular cysts, 201 cases occurred in the maxilla (86.6%) and 31 in the mandible (13.4%) (Table 1).

A total of 270 teeth were affected, the most commonly-involved being the anterior teeth of the maxilla (69.3%), followed by the premolars of the maxilla (12.5%) and the

Table 1 Age, gender, and jawbone region distribution of 232 patients with radicular cysts (n = 232).

Age (years)	
0–9	0
10–19	14 (6.0%)
20–29	57 (24.6%)
30–39	43 (18.5%)
40–49	57 (24.6%)
50–59	33 (14.2%)
60–69	15 (6.5%)
70–79	13 (5.6%)
80–89	0
Sex	
Female	133 (57.3%)
Male	99 (42.7%)
Region	
Maxilla	201 (86.6%)
Mandible	31 (13.4%)

anterior teeth of the mandible (11.1%). The most frequently-involved tooth was the maxillary lateral incisor (38.9%). Neither deciduous teeth nor third molars were found in the present population (Table 2).

A comprehensive histopathological data of the 232 cases are summarized in Table 3. In most cases (228 cases; 98.3%), cysts were lined with nonkeratinized stratified squamous epithelium; two cases contained epithelial lining of the mucoepidermoid epithelium (0.9%) (Fig. 1A), and the remaining two cases contained respiratory epithelium (0.9%) (Fig. 1B). Worthy of note, one case (0.4%) revealed epithelial dysplasia with prominent nuclear hyperchromatism of the epithelial lining (Fig. 1C). Additionally, a hyaline body was seen in two cases (0.9%) (Fig. 1D), and a Rushton body was noted in seven cases (3.0%) (Fig. 1E). Odontogenic epithelial rest was noted in only one case (0.4%). Cholesterol clefts were found in 54 cases (23.3%), and multinucleated giant cells were often observed adjacent to the cholesterol clefts (Fig. 1F). On the other hand, hemosiderins (57 cases; 24.6%) (Fig. 2A), bacterial colonies (22 cases; 9.5%) (Fig. 2B), foreign bodies (44 cases; 19.0%) (Fig. 2C and D), foamy histiocytes (72 cases; 31.0%), and dystrophic calcifications (94 cases; 40.5%) were also observed. Fifty-three cases (22.8%) showed a mixed acute and chronic inflammatory infiltrate (Fig. 2E), whereas chronic inflammatory infiltrate only was noted in 179 cases (77.2%) (Fig. 2F). Of the 179 cases with an infiltrate of chronic inflammatory cells only, 56 cases (24.1%) revealed severe chronic inflammation, whilst 66 (28.4%) and 57 cases (24.6%) demonstrated moderate and mild chronic inflammation, respectively.

Discussion

A radicular cyst is an inflammatory odontogenic cyst (WHO classification) of the jaw, and is associated with an endodontic tooth involvement. The infectious source causes inflammation and necrosis of the dental pulp, which eventually spreads to the peri-radicular tissue [12]. The inflammatory condition stimulates the epithelial rests of Malassez in the peri-radicular tissue, and the epithelial cells then proliferate and develop into a cystic lesion [13,14]. Peri-radicular inflammation may cause pain, swelling, abscess, and fistulae. In most cases, the symptoms and signs can be resolved by conventional endodontic treatment. However, in some cases, the inflammatory condition is not relieved upon root canal therapy, and periapical surgical treatment such as cystic enucleation or curettage needs to be implemented.

In the present study, 86.6% cases of radicular cyst involved the maxillary teeth, the ratio of the lesions occurring in the maxilla to those in the mandible being approximately 6.5:1, which is much higher than the ratios reported by Lalonde & Leubke (1.5:1) [5] and Lin et al. (2.1:1) [4], but lower than those reported by Bhaskar (9.7:1) [6] and Love & Firth (8:1) [7]. Additionally, despite differing reported frequencies, the anterior maxilla was identified as the most frequently-involved region in the current study (69.3%), which was compatible with the studies of Lin et al. (68.4%) [4] and Love & Firth (77.8%) [7], but higher than the data of Lalonde & Leubke (45.7%) [5]. It is also important to note that the most frequently-involved tooth was observed to be the maxillary lateral incisor in various studies with similar frequencies, including Lin et al. (39.2%) [4], Love & Firth (35.8%) [7], and the current study (38.9%).

Of the 232 cases examined in this study, the majority (228 cases; 98.3%) were lined with nonkeratinized stratified squamous epithelium, with a similar frequency of cases to that reported by Lin et al. (116 cases; 99.1%) [4]. Worthy of note, one case revealed epithelial dysplasia of the epithelial lining. Despite neoplastic change of the epithelial lining of a radicular cyst being rare, following a review of the English language literature, one case report presented a squamous odontogenic tumor-like epithelial proliferation of the cystic lining of a radicular cyst [15], and two case reports described squamous-cell carcinoma arising from the cystic lining [16,17]. Although some dental clinicians have differing opinions about the cost and advantages of

Table 2 Distribution of 232 radicular cysts according to the involved region and tooth type (n = 270).[a]

	Maxilla (n = 232)	Mandible (n = 38)
Region		
Anterior	187 (69.3%)	30 (11.1%)
Premolar	34 (12.5%)	3 (1.1%)
Molar	11 (4.1%)	5 (1.9%)
Tooth		
Central incisor	68 (25.2%)	13 (4.8%)
Lateral incisor	105 (38.9%)	8 (3.0%)
Canine	14 (5.2%)	9 (3.3%)
First premolar	22 (8.1%)	2 (0.7%)
Second premolar	12 (4.4%)	1 (0.4%)
First molar	10 (3.7%)	4 (1.5%)
Second molar	1 (0.4%)	1 (0.4%)
Third molar	0	0

[a] Radicular cysts involve more than one tooth in some cases.

Table 3 Histopathological features of 232 radicular cysts (n = 232).

Lining epithelium	
Stratified squamous	228 (98.3%)
Mucoepidermoid	2 (0.9%)
Respiratory	2 (0.9%)
Hyaline body	2 (0.9%)
Rushton body	7 (3.0%)
Odontogenic epithelial rests	1 (0.4%)
Cholesterol clefts	54 (23.3%)
Foamy histiocytes	72 (31.0%)
Hemosiderin deposition	57 (24.6%)
Dystrophic calcification	94 (40.5%)
Foreign bodies	44 (19.0%)
Bacterial colonies	22 (9.5%)
Mixed acute and chronic inflammation	53 (22.8%)
Chronic inflammation only	
Mild	57 (24.6%)
Moderate	66 (28.4%)
Severe	56 (24.1%)

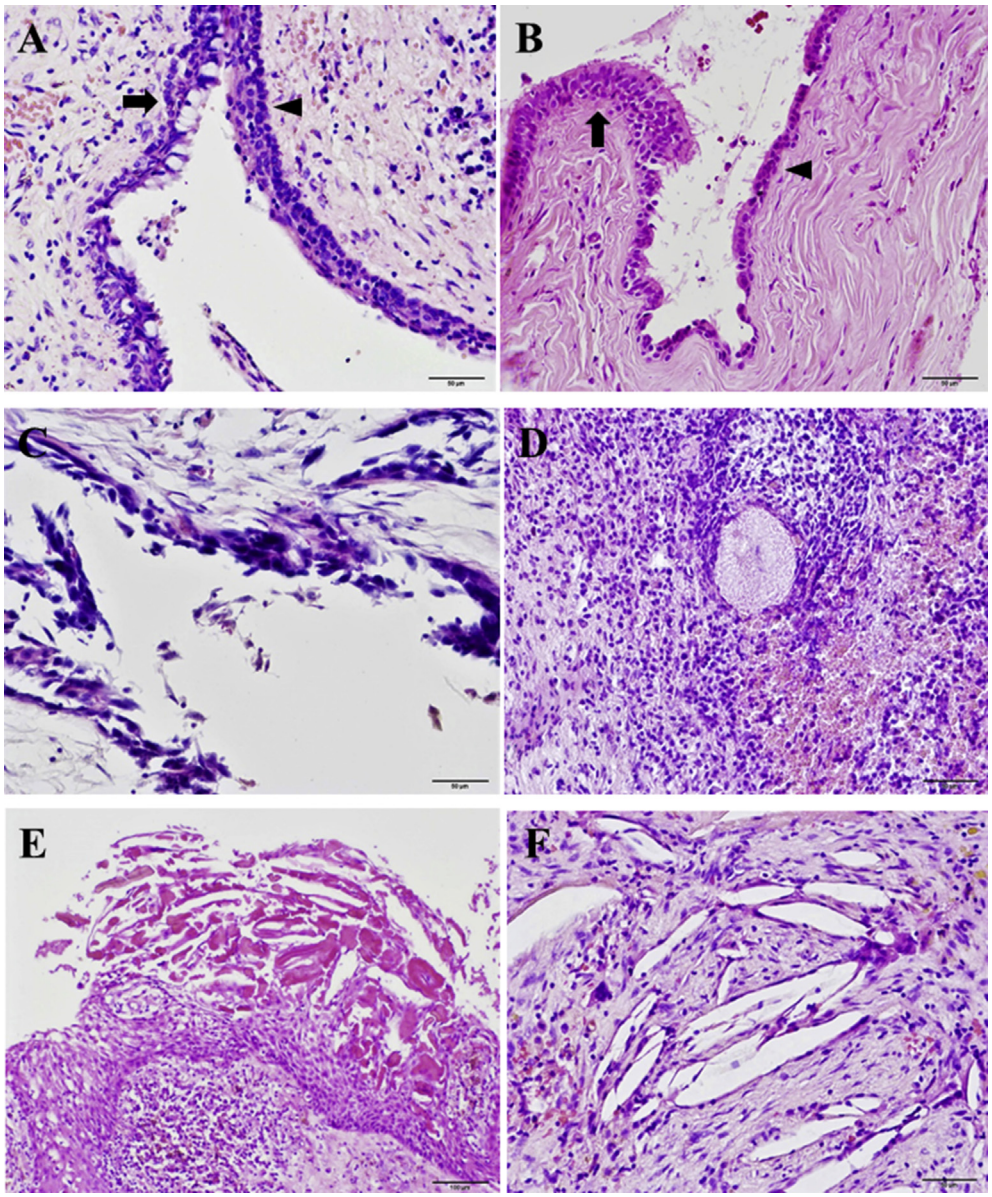

Figure 1. (A) Cyst lined with stratified squamous epithelium (arrow head) and mucoepidermoid epithelium (arrow). (B) Radicular cyst with respiratory epithelium (arrow) and cuboidal epithelium (arrow head). (C) Prominent nuclear hyperchromatism of the lining epithelial cells. (D) Hyaline body surrounded by lymphocytes. (E) Rushton bodies composed of numerous irregular and curvilinear calcified materials. (F) Multinucleated giant cells adjacent to cholesterol clefts. (Hematoxylin and eosin stain; original magnification, A—F, 200×).

histopathological examination of periapical lesions [18—20], the case of a dysplastic cystic lining seen in the current study together with the aforementioned previously-reported cases [15—17] highlight the importance of histopathological examination of specimens upon periapical surgery; in addition, it is warranted because, on occasion, malignant lesions can be found in periapical areas, mimicking periapical pathoses [1,21].

On the other hand, low frequencies of lining of the epithelium with mucous-secreting cells and with respiratory epithelium were noted in the present study (two cases of each; each 0.9%), which was consistent with the findings of Lin et al. [4], in which no respiratory epithelium and one lining epithelium with mucous-secreting cells were reported. These histopathological features could be considered a consequence of metaplasia, and represent the pluripotentiality of the odontogenic epithelium [22].

Rushton bodies are believed to be a secretory product of the odontogenic epithelium due to the fact that they are usually found within the epithelial lining of various odontogenic cysts, such as radicular cysts, dentigerous cysts, and odontogenic keratocysts [8]. Focusing on radicular cysts, Rushton bodies are identified within the cystic epithelium, with a reported frequency of about 10% [8]. However, in the current study population of radicular cysts, Rushton bodies were found only in seven cases (3.0%), with a frequency similar to that reported by Lin et al. [4], who also reported a frequency of approximately 3.0% (4 cases; 3.4%).

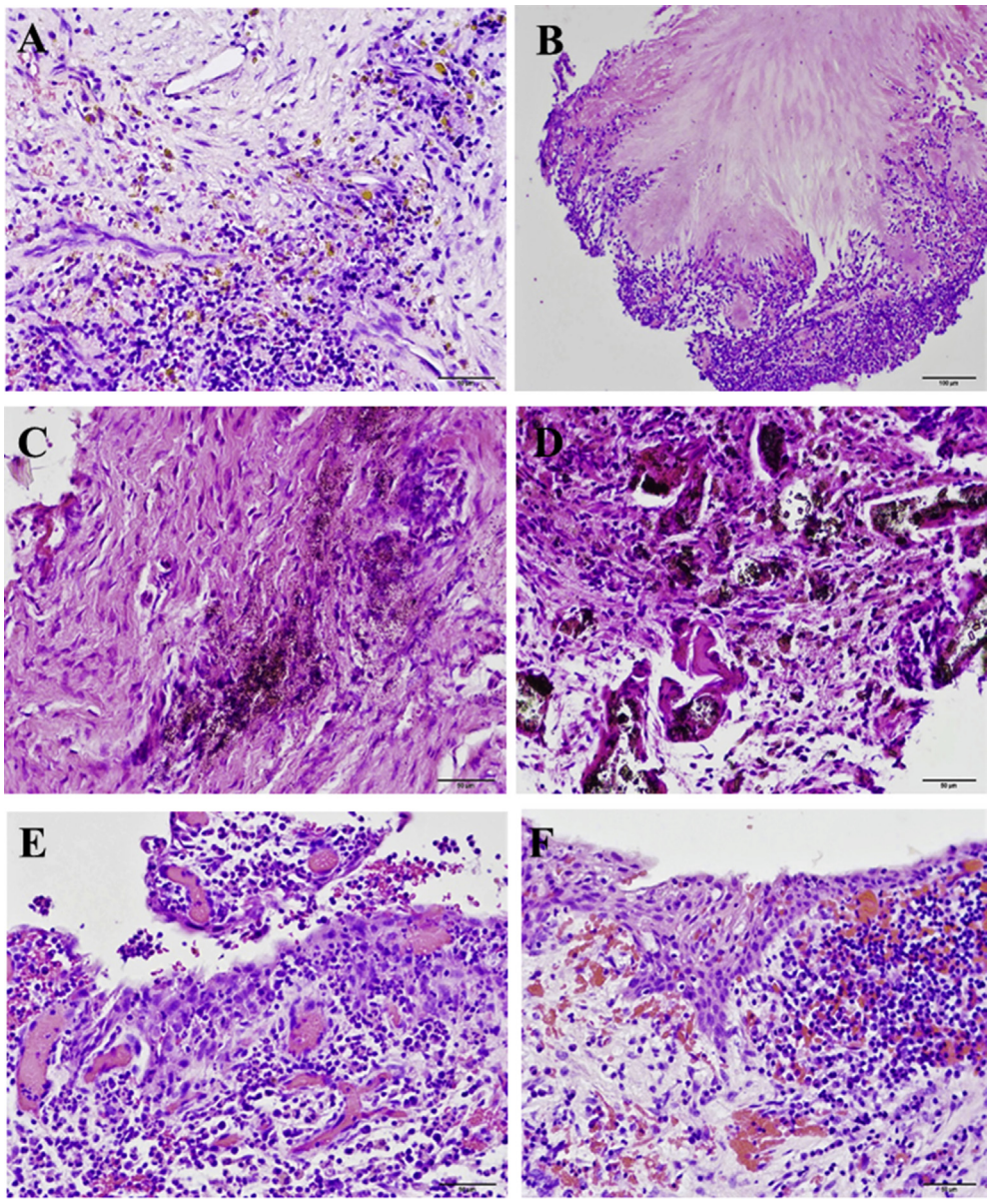

Figure 2. (A) Hemosiderin deposition with a dense infiltrate of chronic inflammatory cells. (B) Non-specific bacterial colonies with peripheral mixed inflammatory infiltrate and aggregates. (C, D) Foreign bodies consisted of black metallic particles, materials for filling of root canal is considered. (E) Mixed acute and chronic inflammatory cells infiltrate in the radicular cyst. (F) Plasma cells and lymphocytes infiltrate in the fibrous cystic wall. (Hematoxylin and eosin stain; original magnification, A, C—F, 200×; B, 100×).

Hyaline bodies were present in two cases (0.9%) in the current study, which were noted to be collagenous rings with surrounding inflammatory cells, and are considered to be an inflammatory exudate [23]. Cholesterol clefts were found in 54 cases (23.3%) in the study, with an incidence consistent with the findings of a review study (18%—44%) [9—11]. Cholesterol crystals are regarded as being derived from disintegrating erythrocytes, lymphoplasma cells, macrophages, and circulating plasma lipids [24]. Foreign bodies were identified in 44 cases (19%) in the current study population, which is a much greater frequency than those reported by Lin et al. (nine cases; 7.7%) [4] and Love & Firth (2 cases; 11.1%) [7]. Consistent with the study of Lin et al. [4], all of the foreign bodies were noted to be root canal filling materials, including sealer and gutta percha. These materials might be extruded to the peri-radicular tissue as a result of previous non-surgical root canal therapy.

Inflammatory infiltrate of varying types and density reflecting the duration of the lesion and the infectious condition is found within cystic walls of radicular cysts. In the present study, 53 cases (22.8%) revealed mixed acute and chronic inflammation, a much lower percentage than that reported in the study of Lin et al. (61 cases; 52.1%) [4]. Regarding cases exhibiting chronic inflammation only, the frequency was almost evenly-distributed amongst severe (56 cases; 24.6%), moderate (66 cases; 28.4%) and mild (57 cases; 24.1%) chronic inflammation, which was in contrast to the study of Lin et al. [4], who demonstrated moderate

chronic inflammation to be of the highest frequency (36 cases; 64.3%), followed by severe (14 cases; 25.0%) and mild (6 cases; 10.7%) chronic inflammation.

In conclusion, the clinicopathological features of 232 cases of radicular cyst of the jawbone were retrospectively reviewed and analyzed. This lesion occurs more frequently in female patients, and most commonly in the 3rd and 5th decades of life. The predominant involved site for this periapical lesion was the maxillary anterior region, and the most commonly-involved tooth was the maxillary lateral incisor. Additionally, within the limitation of the study lacking the follow-up data, the current findings form a valuable resource for clinicopathological reference concerning radicular cysts of the jawbone.

References

[1] Huang HY, Chen YK, Ko EC, Chuang FH, Chen PH, Chen CY, et al. Retrospective analysis of nonendodontic periapical lesions misdiagnosed as endodontic apical periodontitis lesions in a population of Taiwanese patients. Clin Oral Invest 2017; 21:2077—82.

[2] Becconsall-Ryan K, Tong D, Love RM. Radiolucent inflammatory jaw lesions: a twenty-year analysis. Int Endod J 2010;43: 859—65.

[3] Koivisto T, Bowles WR, Rohrer M. Frequency and distribution of radiolucent jaw lesions: a retrospective analysis of 9,723 cases. J Endod 2012;38:729—32.

[4] Lin HP, Chen HM, Yu CH, Kuo RC, Kuo YS, Wang YP. Clinicopathological study of 252 jaw bone periapical lesions from a private pathology laboratory. J Formos Med Assoc 2010;109: 810—8.

[5] Lalonde ER, Luebke RG. The frequency and distribution of periapical cysts and granulomas. An evaluation of 800 specimens. Oral Surg Oral Med Oral Pathol 1968;25:861—8.

[6] Bhaskar SN. Oral surgery—oral pathology conference No. 17, Walter Reed Army Medical Center. Periapical lesions — types, incidence, and clinical features. Oral Surg Oral Med Oral Pathol 1966;21:657—71.

[7] Love RM, Firth N. Histopathological profile of surgically removed persistent periapical radiolucent lesions of endodontic origin. Int Endod J 2009;42:198—202.

[8] Babburi S, Rudraraju AR, Aparna V, Sowjanya P. Rushton bodies: an update. J Clin Diagn Res 2015;9:ZE01—3.

[9] Shear M. The histogenesis of dental cysts. Dent Practit 1963; 13:238—43.

[10] Browne RM. The origin of cholesterol in odontogenic cysts in man. Arch Oral Biol 1971;16:107—13.

[11] Trott JR, Chebib F, Galindo Y. Factors related to cholesterol formation in cysts and granulomas. J Cand Dent Assoc 1973; 38:76—8.

[12] Robinson R, editor. Tumors and cysts of the jaws. Silver Spring MD: ARP Press; 2012.

[13] Lin LM, Huang GTJ, Rosenberg PA. Proliferation of epithelial cell rests, formation of apical cysts, and regression of apical cysts after periapical wound healing. J Endod 2007;33: 908—16.

[14] Keinan D, Cohen RE. The significance of epithelial rests of Malassez in the periodontal ligament. J Endod 2013;39:582—7.

[15] Tarakji B, Shireen A, Umair A, Azzeghaiby SN, Alzoghaibi I, Hanouneh S. Malignant transformation of radicular cyst/residual cyst: a review of literature. Br J Med Med Res 2014; 4:4278—88.

[16] Deihimy P, Karghahi N, Khalesi S. Squamous cell carcinoma arising in a radicular cyst: case report. Int J Prev Med Res 2015;1:22—6.

[17] Kün-Darbois JD, Pare A, Goga D, Laure B. In situ squamous cell carcinoma arising in a mandibular radicular cyst. Eur Ann Otorhinolaryngol Head Neck Dis 2015;132:305—6.

[18] Weisman MI. The importance of biopsy in endodontics. Oral Surg Oral Med Oral Pathol 1998;40:153—4.

[19] Walton RE. Routine histopathological examination of endodontic periradicular surgical specimens-is it warranted? Oral Surg Oral Med Oral Pathol Oral Radiol Endod 1998;86: 505.

[20] Omoregie OF, Saheeb BDO, Odukoya O, Ojo MA. A clinicopathologic correlation in the diagnosis of periradicular lesions of extracted teeth. J Oral Maxillofac Surg 2009;67: 1387—91.

[21] Kontogiannis TG, Tosios KI, Kerezoudis NP, Krithinakis S, Christopoulos P, Sklavounou A. Periapical lesions are not always a sequelae of pulpal necrosis: a retrospective study of 1521 biopsies. Int Endod J 2015;48:68—73.

[22] Yoon JH, Ahn SG, Kim SG, Kim J. An unusual odontogenic cyst with diverse histologic features. Yonsei Med J 2006;28(47): 122—5.

[23] Neville BW, Damm DD, Allen CM, Chi AC. Oral and maxillofacial pathology. 4th ed. Elsevier; 2016. p. 121—3.

[24] Nair PNR, Sjögren U, Sundqvist G. Cholesterol crystals as an etiological factor in non-resolving chronic inflammation: an experimental study in Guinea pigs. Eur J Oral Sci 1998;106: 644—50.