INTERNATIONAL
ENDODONTIC JOURNAL

doi:10.1111/iej.12276

Periapical lesions are not always a sequelae of pulpal necrosis: a retrospective study of 1521 biopsies

T. G. Kontogiannis[1], K. I. Tosios[2], N. P. Kerezoudis[1], S. Krithinakis[1], P. Christopoulos[3] & A. Sklavounou[2]

[1]Department of Endodontics, Dental School, University of Athens, Athens; [2]Department of Oral Pathology and Medicine, Dental School, University of Athens, Athens; and [3]Department of Oral and Maxillofacial Surgery, Dental School, University of Athens, Athens, Greece

Abstract

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. *International Endodontic Journal*, **48**, 68–73, 2015.

Aim To record the incidence of lesions that were not the sequelae of pulpal necrosis (non-SPN) amongst 1521 biopsies of periapical lesions submitted with a clinical diagnosis of a sequelae of pulpal necrosis (SPN).

Methodology A retrospective study of 1521 biopsy request forms of specimens submitted for histopathological examination with a clinical diagnosis 'periapical inflammation', 'periapical abscess', 'periapical granuloma' or 'periapical cyst' during an arbitrarily selected 14-year period was undertaken. Gender and age of the patient, site and maximum diameter of the lesion, symptoms, inclusion of the final diagnosis in the differential diagnosis and specialty of the clinician submitting the biopsy material were recorded in each case. The final diagnosis for each case was extracted from the pathology report, and two groups were formed, SPN and non-SPN lesions. Differences between the respective features of SPN and non-SPN cases were analysed with Yate's chi-square test and *t*-test (significance level $P < 0.05$)

Results In 52 of the 1521 cases examined (3.42%), the histological diagnosis was not consistent with a SPN. In most non-SPN cases, the histopathological diagnosis was not included in the differential diagnosis. The keratocystic odontogenic tumour [odontogenic keratocyst (OKC)] was the most frequent non-SPN lesion (34.62%). Other, yet less frequent, non-SPN lesions included glandular odontogenic cysts, lateral periodontal cysts, central ossifying fibromas as well as malignancies (metastatic carcinomas and Langerhans cell histiocytosis).

Conclusions Non-SPN lesions appeared in the periapical region mimicking a SPN, although rarely. Most of them were developmental cysts, in particular OKCs, but odontogenic tumours, such as ameloblastoma, or malignant lesions were also diagnosed. Histological examination of tissue harvested from periapical lesions should be performed, in particular when those lesions are large.

Keywords: malignant neoplasm, nonodontogenic cyst, odontogenic tumour, periapical disease, periapical granuloma, radicular cyst.

Received 15 November 2013; accepted 25 February 2014

Introduction

Pulp necrosis secondary to inflammation may be followed by the development of a periapical lesion, that is, periapical abscess, periapical granuloma or periapical cyst, collectively termed sequelae of pulpal necrosis (SPN) (Garlock *et al.* 1998, Kuc *et al.* 2000,

Correspondence: Taxiarchis G. Kontogiannis, Department of Endodontics, Dental School, University of Athens, 2 Thivon Street, 115 27 Athens, Greece (Tel.: +0030 6946355003; fax: +0030 2106138485; e-mail: tkontogiannis@hotmail.com).

Vier & Figueiredo 2002). Diagnosis of a SPN is based on clinical and radiographic examination of the involved tooth, and root canal treatment usually results in satisfactory healing (Nary Filho *et al.* 2004). Failure of root canal treatment is an indication for endodontic surgery that may be followed by histopathological examination when an adequate amount of tissue or foreign material is removed (Peters & Lau 2003, European Society of Endodontology 2006).

It has been suggested that careful clinical diagnosis will differentiate an endodontic from a nonendodontic lesion, thus histopathological examination is considered not beneficial to the patient and adds to costs (Weisman 1975, Walton 1998, Omoregie *et al.* 2009). A major argument in favour of this view is the rare recurrence of cases where histopathological examination of tissue harvested through endodontic surgery provided useful diagnostic information (Walton 1998). However, this view has been challenged (Baughman 1999, Ellis 1999, Newton 1999, Ramer 1999, Summerlin 1999, Becconsall-Ryan *et al.* 2010).

A review of the literature reveals that a wide variety of lesions may mimic a SPN, when they develop in a periapical location. These lesions may be noninflammatory developmental odontogenic cysts, such as odontogenic keratocyst (OKC) (August *et al.* 2000, Chapelle *et al.* 2004, Cunha *et al.* 2005), nasopalatine duct cyst, lateral periodontal cyst and traumatic bone cyst (Garlock *et al.* 1998, Kuc *et al.* 2000, Peters & Lau 2003, Silva *et al.* 2003); infectious diseases, such as histoplasmosis, aspergillosis, actinomycosis and viral diseases (Hirshberg *et al.* 2003, Peters & Lau 2003, Slots *et al.* 2003); benign fibro-osseous lesions (Peters & Lau 2003, Sanchis *et al.* 2003, Pérez-García *et al.* 2004); central giant-cell granuloma (CGCG) (Dahlkemper *et al.* 2000, Peters & Lau 2003, Lombardi *et al.* 2006); and odontogenic tumours, such as ameloblastoma (Chapelle *et al.* 2004, Cunha *et al.* 2005). There are also rare reports of malignancies in a periapical location, such as metastatic neoplasms, adenocarcinomas, lymphomas and odontogenic carcinoma (Peters & Lau 2003, Silva *et al.* 2003, Lee *et al.* 2007, Gbolahan *et al.* 2008, Becconsall-Ryan *et al.* 2010, Yamada *et al.* 2010). In a review of the literature, the incidence of non-SPN lesions in periapical location ranged from 0.7% to 5% (Peters & Lau 2003).

The aim of the present study was to record the incidence of non-SPN lesions amongst 1521 biopsies of periapical lesions submitted with a clinical diagnosis of a SPN.

Materials and methods

This is a retrospective study of 1521 biopsy request forms of specimens submitted for histopathological examination to the Department of Oral Pathology and Medicine, Dental School, University of Athens, with a clinical diagnosis 'periapical inflammation', 'periapical abscess', 'periapical granuloma' or 'periapical cyst'. The study was limited to an arbitrarily selected 14-year period (January 1990 to December 2004). The exact type of surgical procedure used to retrieve the specimen (tooth extraction, periapical curettage or apicectomy) was not stated. Cases submitted as 'periapical lesion', 'cyst' or 'odontogenic cyst' were excluded from the study, as those clinical diagnoses could describe non-SPN lesions.

Gender and age of the patient, site and maximum diameter of the lesion, symptoms, inclusion of the final diagnosis in the differential diagnosis and specialty of the clinician submitting the biopsy material [oral surgeon or oral and maxillofacial surgeon (OMFS), general dental practitioner (GP) or endodontist] were recorded in each case. The final diagnosis for each case was extracted from the pathology report, and two groups were formed, SPN and non-SPN lesions. For non-SPN lesions, the diagnoses were verified by reviewing the original slides, according to standard diagnostic criteria (Neville *et al.* 2009).

Differences between the respective features of SPN and non-SPN cases were analysed with Yate's chi-square test and *t*-test (significance level $P < 0.05$), using SPSS Statistics 17.0 software (SPSS, Inc., Chicago, IL, USA).

Results

The final diagnoses were periapical abscess in five cases (0.32%), periapical granulomas in 476 cases (31.28%), radicular cyst in 988 cases (64.91%) and various non-SPN lesions in 52 cases (3.42%). Table 1 shows the main clinical features of the SPN and non-SPN cases studied. Significant differences were found between SPN and non-SPN lesion in the average age of the patients ($P < 0.01$), the average maximum diameter of the lesion ($P < 0.01$) and the presence of symptoms ($P < 0.01$), but the exact nature of those symptoms were not stated.

The final diagnoses of non-SPN lesions are shown in Table 2 and included developmental cysts (75.01%), odontogenic tumours (3.84%) and other lesions (21.15%), amongst them one case each of a

Table 1 Main clinical features of SPN and non-SPN cases

	SPN	Non-SPN	*P*
Gender			
Males	830	30	
Females	636	22	0.89
Ratio	1.3 : 1	1.3 : 1	
Average age (years)	41.34 ± 15.03	47.29 ± 18.78	**0.0043**
Region			
Maxilla	917	28	
Mandible	505	22	0.20
Ratio	1.82 : 1	1.22 : 1	
Average maximum diameter (cm)	1.92 ± 1.27	2.55 ± 1.69	**0.00005**
Symptoms			
Yes	922	31	
No	219	21	**0.00055**

SPN, sequelae of pulpal necrosis.
P-values of statistically significant differences are in bold.

Table 2 Final diagnosis in 52 cases of nonsequelae of pulpal necrosis lesions

Final diagnosis	Number of cases	%
Developmental odontogenic cysts		
Odontogenic keratocyst	18	34.62
Glandular odontogenic cyst	10	19.23
Lateral periodontal cyst or botryoid odontogenic cyst	6	11.54
Calcifying odontogenic cyst	3	5.77
Dentigerous cyst	2	3.85
Odontogenic tumours		
Ameloblastoma	1	1.92
Ameloblastic odontoma	1	1.92
Other lesions		
Fibro-osseous lesion–central ossifying fibroma	4	7.69
Foreign body reaction	2	3.85
Actinomycosis	1	1.92
Focal osteoporotic marrow defect	1	1.92
Metastatic carcinoma	1	1.92
Langerhans cell histiocytosis	1	1.92
Dental follicle	1	1.92
Total	52	100

metastatic malignant neoplasm of unknown primary and Langerhans cell histiocytosis. There was, also, an unusual case of a dental follicle excised from the periapical area of a first pre-molar in a patient that had been previously undergone extraction of an impacted second pre-molar. OKC was the final diagnosis in 18 of 52 non-SPN cases (34.62%). In 50 of 52 non-SPN cases, the differential diagnosis list did not include the final diagnosis.

The distribution of cases diagnosed per specialty of the submitting clinician is shown in Table 3. Most SPN cases (80.41%) and almost all non-SPN cases were submitted by OMFS.

Discussion

Overall, the main clinical features of SPN cases included in the present study are comparable to those of previous reports as it considers the gender and age of the patients and the location of the lesions (Lalonde & Luebke 1968, Spatafore *et al.* 1990, Becconsall-Ryan *et al.* 2010). Granuloma is the most common periapical lesion, but the proportion of granulomas to cysts varies amongst different studies, possibly due to differences in the histopathological diagnostic criteria, as well as the type of procedure utilized for the excision of the lesion (Love & Firth 2009, Becconsall-Ryan *et al.* 2010). In particular, in studies limited to lesions removed through endodontic surgery or tooth extraction, periapical granulomas pre-dominate (Stockdale & Chandler 1988, Spatafore *et al.* 1990, Nobuhara & del Rio 1993, Gbolahan *et al.* 2008, Omoregie *et al.* 2009, Love & Firth 2009), but when all periapical lesions are included, regardless of the type of procedure, the proportion of cysts increases (Bhaskar 1966, Lalonde & Luebke 1968). In the present study, this information was not available, thus all lesions were included. In addition, there was a preponderance of large lesions, as is shown by the average maximum diameter (1.92 ± 1.27 cm) and by the over-representation of cases submitted by OMFS (80.41%), that are more likely to be cysts (Bhaskar 1966).

Non-SPN lesions constituted 3.42% of the cases, and the contributing clinicians did not include them in their differential diagnosis. Other similar studies have reported an incidence of non-SPN lesions between 0.3% and 4% (Table 4). Studies on biopsy

Table 3 Total number of cases and non-SPN cases by specialty of the submitting clinician

	Total number of cases	%	Non-SPN cases	%
OMFS	1223	80.41	51	4.17
GPs	275	18.08	1	0.36
Endodontists	24	1.58	0	0
Total	1521	100	52	3.42

OMFS, oral/oral and maxillofacial surgeons; GPs, general practitioners; SPN, sequelae of pulpal necrosis.

Table 4 Incidence of non-SPN lesions in previous studies and the present one

Reference	Total number of cases	% non-SPN cases
Bhaskar (1966)	2308	1.3
Seltzer *et al.* (1967)	87	1.15
Stockdale & Chandler (1988)	1108	0.3
Spatafore *et al.* (1990)	1659	4
Nobuhara & del Rio (1993)	150	2
Kuc *et al.* (2000)	805	1
Ortega *et al.* (2007)	4006	0.65
Becconsall-Ryan *et al.* (2010)	2419[a]	2
Present study	1521	3.42

SPN, sequelae of pulpal necrosis.
[a]Includes 1570 cases with a provisional diagnosis of periapical granulomas and 849 cases with a provisional diagnosis of periapical cyst.

material, however, do not accurately estimate the incidence of various periapical lesions, as many clinicians do not submit tissue in cases where they have 'no doubt' on their diagnosis or the tissue recovered is considered 'limited' (Kuc *et al.* 2000, Peters & Lau 2003). In addition, the results of those studies are not fully comparable as the inclusion criteria vary, whilst the endodontic status of each tooth and the individual indication for endodontic surgery are not stated. However, non-SPN cases were found in two studies where all periapical lesions collected through endodontic surgery performed according to certain indications were biopsied (Stockdale & Chandler 1988, Nobuhara & del Rio 1993). It is assumed that in those cases, careful clinical and radiographic evaluation of the teeth, considered 'diagnostic' of a SPN (Walton 1998), had been carried out. It should, also, be noticed that occasionally a nonendodontic periapical lesion may cause pulp necrosis, confounding evaluation (Baughman 1999).

Odontogenic keratocyst is the lesion most commonly mimicking a SPN (Garlock *et al.* 1998, Peters & Lau 2003, Cunha *et al.* 2005, Ortega *et al.* 2007, Omoregie *et al.* 2009, Becconsall-Ryan *et al.* 2010), as 0.7% (Peters & Lau 2003, Omoregie *et al.* 2009) to 9% (Garlock *et al.* 1998) of OKCs may present in a periapical region. In the present study, OKC accounted for 34.62% of all non-SPN cases. OKC has an aggressive biological behaviour, with local infiltrative growth and a high tendency for recurrence (Neville *et al.* 2009). Thus, its diagnosis that may be rendered only through histopathological examination would be certainly beneficial to the patient. OKCs and calcifying odontogenic cysts are classified as odontogenic tumours in the most recent WHO classification, referred to as keratocystic odontogenic tumour and calcifying epithelial odontogenic tumour, respectively (Barnes *et al.* 2005), a view not unanimously accepted (Neville *et al.* 2009). A high frequency of recurrence has, also, been reported for lateral periodontal cyst/botryoid odontogenic cyst, as well as glandular odontogenic cyst, both of them found to be common mimickers of a SPN in our study.

Fibro-osseous lesions were the second most common group of non-SPN lesions in the present study, and as in previous reports, most of them were consistent with periapical osseous dysplasias (Bhaskar 1966, Sanchis *et al.* 2003, Pérez-García *et al.* 2004). Those lesions do not affect pulp health, thus proper clinical evaluation should be diagnostic and prevent unnecessary damage to the involved tooth caused by periapical surgery (Sanchis *et al.* 2003, Pérez-García *et al.* 2004).

Periapical ameloblastomas are unusual and Chapelle *et al.* (2004) found 19 such cases in 21 years, accounting for approximately 0.7% of the periapical lesions they studied. CGCG usually represents approximately 5% of non-SPN cases, and at least one case of a CGCG clinically diagnosed as a SPN lesion may be found in many studies (Spatafore *et al.* 1990, Dahlkemper *et al.* 2000, Kuc *et al.* 2000, Peters & Lau 2003, Lombardi *et al.* 2006); however, no case was found in the present series.

Metastatic carcinomas may imitate a SPN, although rarely (Spatafore *et al.* 1990, Peters & Lau 2003), but failure to diagnose them may result in serious delay in management and worsen prognosis for the patient (Lee *et al.* 2007). McClure *et al.* (2013) found 26 cases (2.1%) of metastatic malignancies in a periapical location amongst 1221 patients and Shen *et al.* (2009) 20 cases (0.21%) amongst 9239 patients. Lung and breast were the most common primary sites, and there was a predilection for the posterior mandible. In the present study, one case of metastatic malignancy was found. Information retrieved by the biopsy request form as well as the histopathological report indicated that its primary origin was unknown and manifested as a periapical lesion related to a right maxillary canine.

Langerhans cell histiocytosis encompasses a group of rare disorders of the reticuloendothelial system characterized by abnormal proliferation of Langerhans cells (Neville *et al.* 2009). Cases masquerading as SPNs have been reported rarely, and most of them

are localized eosinophilic granulomas (Madrigal-Martínez-Pereda *et al.* 2009) that behave in a benign manner. As an oral lesion may occasionally be the primary manifestation of Langerhans cell histiocytosis, early diagnosis is of outmost importance for the patient.

Most periapical biopsies and non-SPN cases were submitted by OMFS, followed by GPs and endodontists. The percentage of periapical biopsies submitted by GPs (18.08%) is comparable to that reported from Northern Ireland (12%) (Cowan *et al.* 1995), New Zealand (16%) (Becconsall-Ryan *et al.* 2010), the United Kingdom (21%) (Warnakulasuriya & Johnson 1999) and Spain (24.5%) (Franklin & Jones 2006). As GPs do not usually perform endodontic surgery and refer patients to OMFS or endodontists, it is possible that those cases represent tissue curetted from the tooth socket after an extraction. The most possible explanation for the limited number of cases submitted by endodontists is that they feel confident in their provisional diagnosis, as they routinely perform all proper diagnostic procedures (Garlock *et al.* 1998, Cunha *et al.* 2005, Omoregie *et al.* 2009). On the other hand, OMFS are trained to consider submission of any tissue removed from the oral and maxillofacial region for pathologic examination. The percentage of non-SPN lesions to the total number of biopsies submitted by GPs was 0.36% and OMFS 4.17%, compared to 6.6% and 6.4%, respectively, in the study of Kuc *et al.* (2000). This may be partly attributed to the finding of the present study that non-SPN cases, considered as a group, were larger that SPN lesions and large lesions are usually referred for management to OMFs. Although the significant differences found in the present study between SPN and non-SPN lesions should be considered with caution, as non-SPN lesions constitute a variable group of lesions with different clinical features, large size should be taken into account when clinicians consider whether to submit a lesion for histopathological examination.

Conclusion

Non-SPN lesions may appear in periapical regions mimicking a SPN, although rarely. Most of them are developmental cysts, in particular OKCs, but odontogenic tumours, such as ameloblastoma or malignant lesions may also be found. Thus, histopathological examination of tissue harvested from periapical lesions should be performed, in particular when those lesions are large.

Acknowledgements

There is no conflict of interest related to this study.

References

August M, Faquin W, Troulis M, Kaban L (2000) Differentiation of odontogenic keratocysts from nonkeratinizing cysts by use of fine-needle aspiration biopsy and cytokeratin-10 staining. *Journal of Oral and Maxillofacial Surgery* **58**, 935–40.

Barnes L, Eveson JW, Reichart P, Sidransky D (2005) *World Health Organization Classification of Tumors: Pathology and Genetics of Head and Neck Tumors*. Lyon, France: IARC Press.

Baughman RA (1999) To the editor [letter]. *Oral Surgery, Oral Medicine, Oral Pathology* **87**, 644–5.

Becconsall-Ryan K, Tong D, Love RM (2010) Radiolucent inflammatory jaw lesions: a twenty-year analysis. *International Endodontic Journal* **43**, 859–65.

Bhaskar SN (1966) Oral surgery – oral pathology conference No. 17, Walter Reed Army Medical Center. Periapical lesions – types, incidence, and clinical features. *Oral Surgery, Oral Medicine, Oral Pathology* **21**, 657–71.

Chapelle KA, Stoelingaa PJ, de Wildeb PC, Brounsc JJ, Voorsmita RA (2004) Rational approach to diagnosis and treatment of ameloblastomas and odontogenic keratocysts. *British Journal of Oral and Maxillofacial Surgery* **42**, 381–90.

Cowan CG, Gregg TA, Kee F (1995) Prevention and detection of oral cancer: the views of primary care dentists in Northern Ireland. *British Dental Journal* **179**, 338–42.

Cunha EM, Fernandes AV, Versiani MA, Loyola AM (2005) Unicystic ameloblastoma: a possible pitfall in periapical diagnosis. *International Endodontic Journal* **38**, 334–40.

Dahlkemper P, Wolcott JF, Gordon A, Pringle GAHicks LM (2000) Periapical central giant cell granuloma: A potential endodontic misdiagnosis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **90**, 739–45.

Ellis GL (1999) To biopsy or not. *Oral Surgery, Oral Medicine, Oral Pathology* **87**, 642–3.

European Society of Endodontology (2006) Quality guidelines for endodontic treatment: consensus report of the European Society of Endodontology. *International Endodontic Journal* **39**, 921–30.

Franklin CD, Jones AV (2006) A survey of oral and maxillofacial pathology specimens submitted by general dental practitioners over a 30-year period. *British Dental Journal* **200**, 447–50.

Garlock J, Pringle G, Hicks ML (1998) The odontogenic keratocyst. A potential endodontic misdiagnosis. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **85**, 452–6.

Gbolahan O, Fatusi O, Owotade F, Akinwande J, Adebiyi K (2008) Clinicopathology of soft tissue lesions associated

with extracted teeth. *Journal of Oral and Maxillofacial Surgery* **66**, 2284–9.

Hirshberg A, Tsesis I, Metzger Z, Ilana Kaplan I (2003) Periapical actinomycosis: a clinicopathologic study. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **95**, 614–20.

Kuc I, Peters E, Pan J (2000) Comparison of clinical and histologic diagnoses in periapical lesions. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **89**, 333–7.

Lalonde ER, Luebke RG (1968) The frequency and distribution of periapical cysts and granulomas. *Oral Surgery, Oral Medicine, and Oral Pathology* **25**, 861–8.

Lee KJ, Cheng SJ, Lin SK *et al.* (2007) Gingival squamous cell carcinoma mimicking a dentoalveolar abscess: report of a case. *Journal of Endodontics* **33**, 177–80.

Lombardi T, Bischof M, Nedir R *et al.* (2006) Periapical central giant cell granuloma misdiagnosed as odontogenic cyst. *International Endodontic Journal* **39**, 510–5.

Love RM, Firth N (2009) Histopathological profile of surgically removed persistent periapical radiolucent lesions of endodontic origin. *International Endodontic Journal* **42**, 198–202.

Madrigal-Martínez-Pereda C, Guerrero-Rodríguez V, Guisado-Moya B, Meniz-García C (2009) Langerhans cell histiocytosis: literature review and descriptive analysis of oral manifestations. *Medicina oral, Patologia oral y Cirugia bucal* **14**, E222–8.

McClure SA, Movahed R, Salama A, Ord RA (2013) Maxillofacial metastases: a retrospective review of one institution's 15-year experience. *Journal of Oral and Maxillofacial Surgery* **71**, 178–88.

Nary Filho H, Matsumoto MA, Fraga SC, Gonçales ES, Sérvulo F (2004) Periapical radiolucency mimicking an odontogenic cyst. *International Endodontic Journal* **37**, 337–44.

Neville BW, Damm DD, Allen CM, Bouquot JE (2009) *Oral and Maxillofacial Pathology*, 3rd edn. St Louis, USA: Saunders Elsevier.

Newton CW (1999) To biopsy or not. *Oral Surgery, Oral Medicine, Oral Pathology* **87**, 642–3.

Nobuhara WK, del Rio CE (1993) Incidence of periradicular pathoses in endodontic treatment failures. *Journal of Endodontics* **19**, 315–8.

Omoregie OF, Saheeb BDO, Odukoya O, Ojo MA (2009) A clinicopathologic correlation in the diagnosis of periradicular lesions of extracted teeth. *Journal of Oral and Maxillofacial Surgery* **67**, 1387–91.

Ortega A, Fariña V, Gallardo A, Espinoza I, Acosta S (2007) Nonendodontic periapical lesions: a retrospective study in Chile. *International Endodontic Journal* **40**, 386–90.

Pérez-García S, Berini-Aytés L, Gay-Escoda C (2004) Ossifying fibroma of the upper jaw: report of a case and review of the literature. *Medicina Oral* **9**, 333–9.

Peters E, Lau M (2003) Histopathologic examination to confirm diagnosis of periapical lesions: a review. *Journal of the Canadian Dental Association* **69**, 598–600.

Ramer M (1999) To biopsy or not. *Oral Surgery, Oral Medicine, Oral Pathology* **87**, 643–4.

Sanchis JM, Peñarrocha M, Balaguer JM, Camacho F (2003) Cemento-ossifying mandibular fibroma: a presentation of two cases and review of the literature. *Medicina Oral* **9**, 69–73.

Seltzer S, Bender IB, Smith J, Freedman I, Nazimov H (1967) Endodontic failures – an analysis based on clinical, roentgenographic and histologic findings. Part I. *Oral Surgery, Oral Medicine, Oral Pathology* **23**, 500–16.

Shen ML, Kang J, Wen YL *et al.* (2009) Metastatic tumors to the oral and maxillofacial region: a retrospective study of 19 cases in West China and review of the Chinese and English literature. *Journal of Oral and Maxillofacial Surgery* **67**, 718–37.

Silva TA, Batista AC, Camarini ET, Lara VS, Consolaro A (2003) Paradental cyst mimicking a radicular cyst on the adjacent tooth: case report and review of terminology. *Journal of Endodontics* **29**, 73–6.

Slots J, Sabeti M, Simon J (2003) Herpesviruses in periapical pathosis: An etiopathogenic relationship? *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **96**, 327–31.

Spatafore CM, Griffin JA Jr, Keyes GG, Wearden S, Skidmore AE (1990) Periapical biopsy report: an analysis over a 10-year period. *Journal of Endodontics* **16**, 239–41.

Stockdale CR, Chandler NP (1988) The nature of the periapical lesion – a review of 1108 cases. *Journal of Dentistry* **16**, 123–9.

Summerlin DJ (1999) Periapical biopsy or not. *Oral Surgery, Oral Medicine, Oral Pathology* **88**, 645–6.

Vier FV, Figueiredo JAP (2002) Prevalence of different periapical lesions associated with human teeth and their correlation with the presence and extension of apical external root resorption. *International Endodontic Journal* **35**, 710–9.

Walton RE (1998) Routine histopathological examination of endodontic periradicular surgical specimens – is it warranted? *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **86**, 505.

Warnakulasuriya KA, Johnson NW (1999) Dentists and oral cancer prevention in the UK: opinions, attitudes and practices to screening for mucosal lesions and to counseling patients on tobacco and alcohol use: baseline data from 1991. *Oral Diseases* **5**, 10–4.

Weisman MI (1975) The importance of biopsy in endodontics. *Oral Surgery, Oral Medicine, Oral Pathology* **40**, 153–4.

Yamada T, Mishima K, Ota A *et al.* (2010) A case of ATLL (adult T-cell leukemia/lymphoma) mimicking odontogenic infection. *Oral Surgery, Oral Medicine, Oral Pathology, Oral Radiology and Endodontology* **109**, e51–5.