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## Assessment of conformity between clinical (radiological) and histopathological diagnoses of chronic inflammatory periapical lesions treated with apicoectomy

Clinical and histopathological diagnoses of periapical lesions  
Research article

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**Abstract:** Objectives: Periapical inflammation is one of the most common pathologies within the jaws, leading to the destruction of periodontal ligaments, bone resorption and the formation of periapical granulomas or radicular cysts. The final diagnosis can be made only on the basis of histopathological examination. The aim of the study was to assess the conformity between clinical and histopathological diagnosis of inflammatory periapical lesions treated with apicoectomy.

**Materials and Methods:** The case histories of 52 patients subjected to surgical treatment at the Clinic of Conservative Dentistry with Endodontics between 2008 and 2018 were analyzed. Demographic data (age, gender), clinical (radiological) diagnosis, and data on the presence of sinus tracts and causal tooth were obtained from patients' records.

**Results:** In the light of clinical and radiological examination, 32 (61.5%) periapical granulomas, 18 (34.6%) radicular cysts and 2 (3.9%) periapical scars were diagnosed, whereas the result of histopathological examination revealed granuloma in 34 (65.4%) cases and in 18 (34.6%) — radicular cyst. For clinical diagnosis of granuloma, the result coincided with the result of the histopathological examination in 28 cases, and in the case of cysts in 14. The analysis showed a significant relationship between the clinical and histopathological diagnoses ( $p < 0.05$ ).

**Conclusions:** The study emphasizes the importance of histopathological assessment for the proper diagnosis of periapical lesions.

**Clinical Relevance:** The article emphasizes the high importance of histopathological examination for the correct diagnosis of chronic inflammatory periapical lesions.

**Keywords:** periapical lesions, clinical examination, histopathological examination, radicular cyst.

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## Introduction

Periapical inflammation is one of the most common pathologies within the alveolar processes of the maxilla and the alveolar part of the mandible, leading to the destruction of periodontal ligaments as well as to bone resorption and the formation of pathological granulation tissue [1]. Bacteria play the most important role in its etiopathogenesis, some of which have a toxic effect on tissues by the direct production of bacterial toxins and enzymes. Most of them, however, act in unchanged form by endotoxin production resulting in specific humoral and cellular immune responses. Periapical tissue defect occurs most rapidly during the acute phase of inflammation, slowing down in the subsequent chronic phase; nevertheless, the process is continuously progressive in nature. Periapical granulomas and radicular cysts are most often detected accidentally during radiological examination accompanying common dental procedures. There is a high risk of misdiagnosis of chronic periapical lesions due to a marked similarity of the radiological features of granulomas and periapical radicular cysts [2]. Both are visible as intraosseous defects bordered by healthy bone tissue. The radicular cyst has a smoother, more regular outline and is described as an oval or round radiolucency surrounded by a sclerotic margin. In case of infection of the cyst, its margins may become blurred. Radiological features of granulomas are similar to those of cysts, although it is possible to distinguish a central zone and blurred arrangement of trabeculae within them, as well as a peripheral zone with more pronounced trabeculation transitioning to healthy bone [3]. Only histopathological examination of the surgical specimen enables the final diagnosis to be made.

Bone resorption is a complex process involving interactions between osteoclasts and osteoblasts, which are controlled by the RANKL/RANK/OPG system. Osteoprotegerin (OPG), a protein of the family of tumor necrosis factor (TNF) receptors, binds to RANKL which activates the process of maturation and differentiation of osteoclasts (receptor activator of nuclear factor NF- $\kappa$ B ligand) and, by blocking it, prevents excessive bone resorption. The RANK receptor (receptor activator of nuclear factor NF- $\kappa$ B) occurs on preosteoclasts; its stimulation initiates osteolysis. The preponderance of OPG over RANK leads to a reduction in the process of bone destruction [4, 5].

The radicular cyst is the most commonly occurring cyst of the jaws, constituting 62% of odontogenic cysts and 52.5% of all bone cysts of the human body. Its pocket variant, the interior of which passes through into the lumen of the canal, is morphologically distinct from the true radicular cyst, in which no such contact exists. The radicular cyst is formed from periodontal cell rests of Malassez under the inflammatory conditions which develop on the basis of necrotic tooth pulp. Additionally, the growth of epithelium can be stimulated by *Actinobacillus actinomycetemcomitans*, *Porphyromonas gingivalis*, or *Escherichia coli* [6, 7].

In accordance with the guidelines of the European Endodontic Society, surgical treatment is recommended for periapical lesions visible in the radiological image and/or with pain symptoms in cases of root canal obliteration, as well as for lesions with endodontic material pushed outside of the root canal [8].

The aim of the present study is to assess the conformity between clinical (radiological) and histopathological diagnoses of chronic inflammatory periapical lesions treated with apicoectomy.

## Material and Methods

A retrospective analysis of the medical records of patients subjected to surgical treatment of chronic inflammatory periapical lesions at the Clinic of Conservative Dentistry with Endodontics at the University Dental Clinic between 2008 and 2018. Demographic data (age, gender), clinical (radiological) diagnosis, and data on the presence of sinus tracts and causative tooth were obtained from patients' records. The study protocol was accepted by the Bioethics Committee of the Jagiellonian University, no.1072.6120.90.2018.

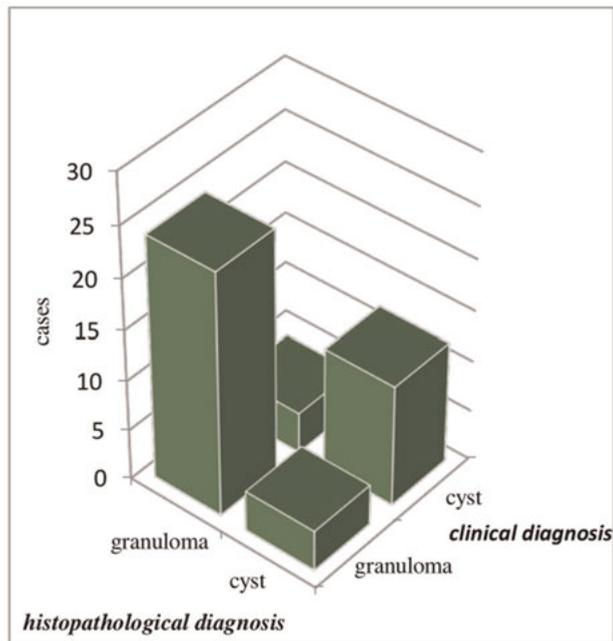
All teeth qualified for surgical treatment had previously undergone root canal treatment. Under the local anesthesia with 4% articaine with 1:100.000 epinephrine (Septanest, Septodont) submarginal or gingival incision was made in the oral vestibule, using a blade no. 15. Subsequently, a mucoperiosteal flap was raised. In most cases, there was no need for osteotomy, due to significant destruction of the vestibular cortical bone. Periapical curettage included removal of pathological tissue using a Lucas curette (Hu-Friedy, Chicago, USA). Surgical specimen was placed in a container with 10% formalin and, following accurate description, sent out for histopathological examination. The root was examined using a Karl Kaps surgical microscope (Germany) at 20× magnification. Using a Lindemann-type surgical drill with a low-speed tip, apicoectomy was performed on a section of about 3 mm. Root canal retropreparation was subsequently performed with the aid of an ultrasound RE2 tip (EMS, Nyon, Switzerland) to a depth of 3 mm. The canal was backfilled with ProRoot MTA (Dentsply, Germany). The mucoperiosteal flap was repositioned, and the incision was sutured with Prolene 6.0 (nonabsorbable, single-fiber, polypropylene), with a single-knot suture. Post-surgery recommendations were issued.

The results of the histopathological examination were divided into 3 groups: periapical granulomas, radicular cysts, and other lesions.

Statistical analysis was carried out using the STATISTICA 12 program. The relationship between individual variables was evaluated using Pearson's chi-squared test or Spearman's rank correlation test. For both tests, appropriate correlation coefficients determining the strength of the relationship were calculated. A value of 0.05 was adopted as the critical level of significance.

## Results

Data obtained from medical records of 52 patients, comprising of 30 (57.7%) females and 22 (42.3%) males, were subjected to analysis. The age of the patients ranged from 15 to 81 years; the average age was 38 years (SD = 16.02). Based on clinical and radiological examination, 32 (61.5%) periapical granulomas, 18 (34.6%) radicular cysts, and 2 (3.9%) periapical scars were diagnosed, whereas the result of histopathological examination indicated 34 (65.4%) granulomas and 18 (34.6%) cysts. The results of clinical diagnosis of granuloma coincided with the result of histopathological examination in 28 cases, and, in the case of cysts, in 14. The analysis showed a significant relationship between clinical and histopathological diagnosis ( $p < 0.05$ ) (Fig. 1).



**Fig. 1.** Conformity between clinical and histopathological diagnoses.

Chronic inflammatory lesions were more common in the maxillas, (43, or 82.7%) than in the mandible (9, or 17.3%). The most common causative tooth was the upper right second incisor (21.1%), less often the upper right first incisor (17.3%) and the upper left second incisor (11.5%) (Fig. 2).

Gingival sinus tracts were reported in 19 (36.5%) patients in the maxillas and in 3 (5.8%) in the mandible; in the remaining 30 (57.7%) patients, no sinus tracts were

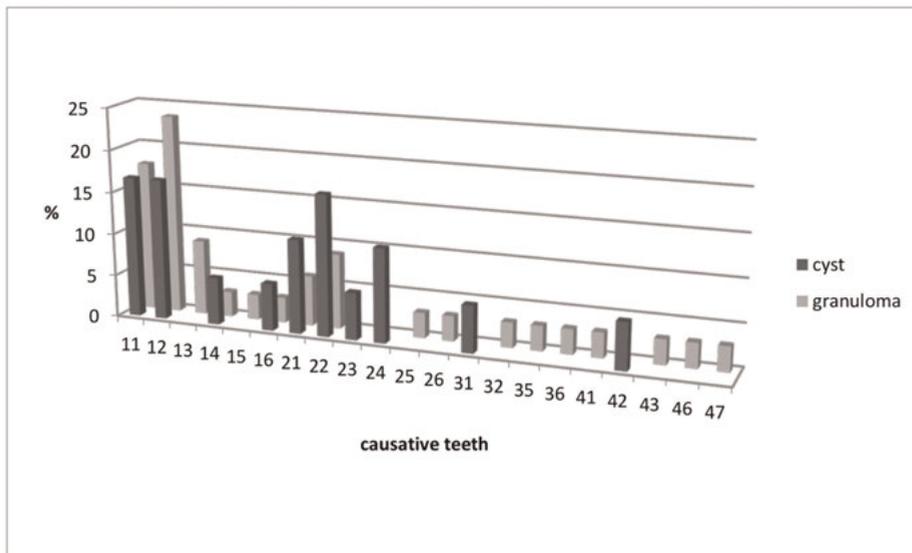


Fig. 2. Result of histopathological examination of periapical lesions in individual causative teeth.

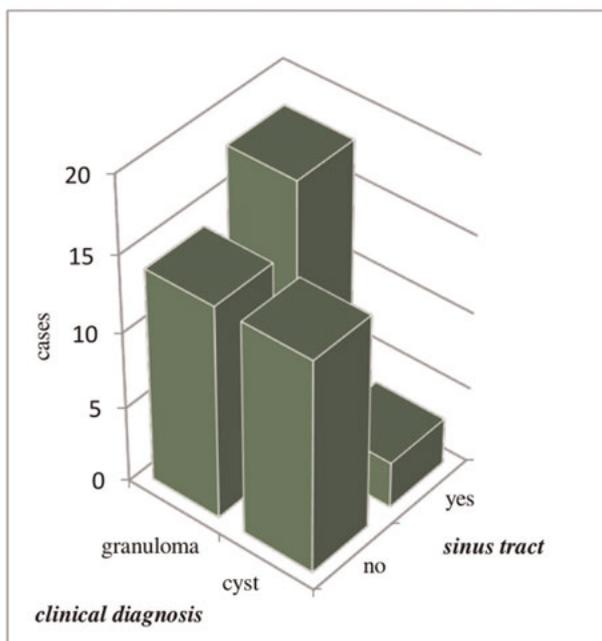
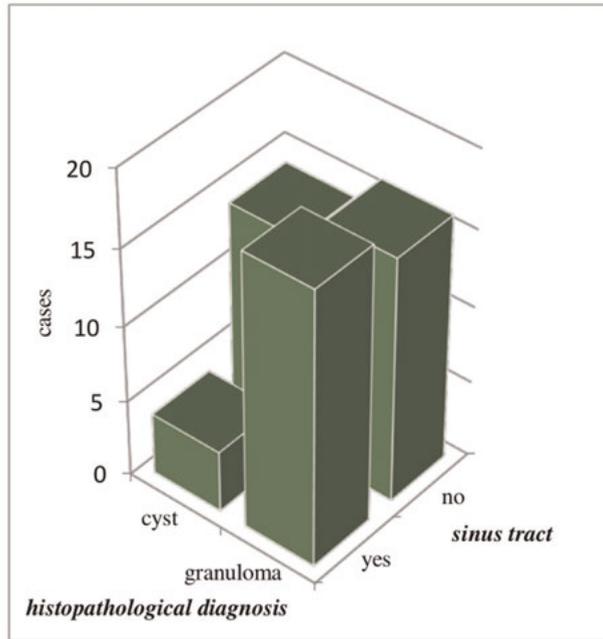


Fig. 3. Relationship between occurrence of sinus tract and clinical diagnosis.

found. No correlation between incidence of gingival sinus tracts and the location of the lesions was noted ( $p > 0.005$ ). Sinus tracts occurred more frequently when granuloma was diagnosed, on the basis of both clinical ( $p = 0.019$ ) (Fig. 3) and histopathological ( $p = 0.030$ ) (Fig. 4) examination.



**Fig. 4.** Relationship between the presence of sinus tract and histopathological diagnosis.

## Discussion

The results of many studies indicate that there is no agreement regarding the type of periapical lesions which are frequently qualified for surgical treatment. In their analysis of 255 biopsies from periapical lesions, Diegues *et al.* found that the clinical diagnosis was consistent with the histopathological diagnosis in 75% of cases, while different in the remaining 25%. Cysts accounted for 135 (53%), granulomas — 107 (42%), and abscesses — 13 (5%) of all studied lesions [9]. Similar results were obtained in the current analysis.

However, a preponderance of periapical granulomas over cysts was found by Love *et al.* who examined the result of a histopathological assessment of chronic periapical lesions of teeth subjected to the root canal treatment followed by apicoectomy [10]. Akinyamoju *et al.* analyzed 104 cases of periapical biopsies, among which, on the basis of histopathological examination, they diagnosed 71 (68.3%) periapical granulomas,

31 (29.8%) radicular cysts, and 2 (1.9%) other lesions. A total of 58 (56.9%) lesions were located in the anterior region of the maxilla, most of them (23, or 22.1%) observed in the first incisor of the left maxilla [11]. Similarly, Lin *et al.* conducted a histopathological study of 252 periapical lesions, consisting of 128 (50.8%) periapical granulomas, 117 (46.4%) radicular cysts, and 7 periapical scars (2.8%). They found 66 (26.2%) lesions in the mandible and 186 (73.8%) in the maxilla, of which 134 were in the anterior region. The second most common causative tooth was the second incisor of the maxilla (64%) [12]. Carrillo *et al.* also found a preponderance of lesions of the granuloma type (65.7%) in material encompassing 70 periapical lesions following apicoectomy. Other lesions included apical scars (25.7%) and cystic lesions (8.6%) [13]. These studies confirm that chronic periapical changes qualified for surgery were most commonly located in the anterior region of the maxillas, which is consistent with the results of the current study.

Currently, the best way to verify a diagnosis is to perform a histopathological examination. New diagnostic methods are being sought that will enable diagnosis before starting therapy. This is particularly important in the case of chronic periapical inflammation, where the correct diagnosis at the beginning would allow you to choose the optimal treatment method. Interesting research was carried out by Obuchowicz *et al.*, whose purpose was to check whether additional image processing by the method of digital intraoral radiography (DIR) based on texture description methods improves the recognition and differentiation of periapical lesions. Thanks to the use of IT methods, it becomes possible to isolate interesting diagnostician of lesions. DIR image analysis protocols incorporating clustering with the k-means approach (CLU), texture features derived from co-occurrence matrices, first-order features (FOF), gray-tone difference matrices, run-length matrices (RLM), and local binary patterns, were used to transform DIR images derived from 161 input images into textural feature maps. These maps were used to determine the capacity of the DIR representation technique to yield information about the shape of a structure, its pattern, and adequate tissue contrast. The effectiveness of the textural feature maps with regard to detection of lesions was revealed by two radiologists independently with consecutive interrater agreement. High sensitivity and specificity in the recognition of radiological features of lytic lesions, i.e., radiodensity, border definition, and tissue contrast, was accomplished by CLU, FOF energy, and RLM. Detection of sclerotic lesions was refined with the use of RLM. FOF texture contributed substantially to the high sensitivity of diagnosis of sclerotic lesions. Specific DIR texture-based methods markedly increased the sensitivity of the DIR technique. Therefore, application of textural feature mapping constitutes a promising diagnostic tool for improving recognition of dimension and possibly internal structure of the periapical lesions [14].

## Summary

A significant relationship between clinical and histopathological diagnosis was demonstrated in the analyzed material. Among chronic inflammatory changes in periapical tissues that were surgically treated, periapical granulomas were more common. It is worth emphasizing the importance of histopathological examination in the correct diagnosis of chronic inflammatory periapical lesions.

## Conflict of interest

None declared.

## Funding

The study was not funded.

## Ethical approval

The study protocol was accepted by the Bioethics Committee of the Jagiellonian University, no.1072.6120.90.2018.

## Informed consent

Not applicable.

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