

# EDITORIAL

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## Comparative Analysis and Mutual Relations Between Marginal Periodontitis and Periapical Lesions – Literature Review

### Charakterystyka porównawcza i wzajemne relacje między brzeżnym i okołowierzchołkowym zapaleniem przyzębia – przegląd piśmiennictwa

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A – research concept and design; B – collection and/or assembly of data; C – data analysis and interpretation;  
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#### Abstract

An analysis is presented of the relation between cases of low and medium advanced periodontitis and apical periodontitis. The systemic and local effects of the above are discussed. Both phenomena are caused by bacterial infections; therefore, inflammation is a predominant symptom. Oxidative stress occurring in these cases recedes after treatment. In the case of apical periodontitis, the correlation between the reduction of oxidative stress markers in serum and endodontic treatment is visible after 90 days. Polymicrobial synergy is very important in the context of connections between apical periodontitis and chronic periodontitis. Cooperation between particular bacteria species significantly increases their virulence. *Porphyromonas gingivalis* and *Filifactor alocis* are examples of such cooperation, as are *Aggregatibacter actinomycetemcomitans* and *Streptococcus gordonii*. Pathways of communication between the dental pulp and periodontal tissues are known; however, cases of their infection (even in advanced stages of periodontitis) are rare. The complicated structure of the dental pulp and its abilities for regeneration and repair might be of key importance in treating combined periodontic-endodontic lesions (*Dent. Med. Probl.* 2015, 52, 3, 265–268).

**Key words:** oxidative stress, apical periodontitis, marginal periodontitis, polymicrobial synergy.

**Słowa kluczowe:** stres oksydacyjny, zapalenie przyzębia okołowierzchołkowego, zapalenie przyzębia brzeżnego, synergia polibakteryjna.

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Chronic marginal periodontitis and apical periodontitis are two separate diseases of different etiology, symptoms and nature. However, these diseases concern tissues of the same apparatus for the suspension of the teeth. In both cases, the inflammatory processes concern the alveolar bone and periodontal tissues. Endodontic-periodontal syndrome occurs either when advanced destructive-inflammatory processes of the marginal periodontium reach the apex of the tooth or when extensive apical lesions connect to the periodontal pocket. Over the last decade the central theme of

numerous controversies and disputes has revolved around the relationship between periodontal disease and its influence on the condition of the pulp inside the root canal. In the literature, there are new classifications for this unit, and authors have tried to improve the systematization of the problem of the diagnosis and treatment of these syndromes. The most recent classification introduced by Al-Fouzan in 2014 seems to cover all the relevant circumstances of the comorbidity of the pulp and periodontal tissues. It is based on the frequently cited Simon classification (1972), but

it extends to some cases described in this text in which two inflammatory bacterial processes derived from independent sources may influence their mutual advancement [1]. Very few scientific reports discuss the interrelationship between low or medium changes in the course of marginal periodontitis and apical periodontitis. There are indications suggesting direct interaction between both pathologies. It is statistically proven that advanced periodontitis impacts upon the condition of the pulp [2, 3]. Cardon et al. [4] reported a correlation between connective tissue attachment loss and the reduced sensitivity of the pulp.

Is it therefore possible that patients who suffer from chronic periodontal infection develop apical periodontitis differently than patients with a healthy periodontium? Chronic periodontitis – one of the most common chronic diseases in the world – is an infectious inflammatory disease, which occurs following tissue damage to the suspension apparatus of the teeth. Advanced forms of periodontitis may affect approximately 15% of the population [5]. Inflammatory processes in periodontal tissues are initiated by bacteria (predominantly anaerobic gram-negative), but a significant level of tissue destruction is associated with host immune responses modified by genetic and environmental factors. Although the direct source of the infection is in the oral cavity and concerns the teeth and surrounding tissues, the consequences of this disease are also considered to be systemic. Bacteria or toxins released by them can pass through the damaged epithelium of the periodontal pocket to the blood stream and into the organs. It has been proven that periopathogens can evoke the disease in organs far from the oral cavity (eg. brain abscesses, pneumonia, infection of prostheses and artificial heart valves) [6]. The systemic effects of marginal chronic periodontitis mainly include an increase in inflammatory mediators in blood levels. Several studies have reported that people who are generally healthy and suffering from chronic marginal periodontitis present elevated levels of acute phase proteins and mediators of inflammation in serum, such as CRP, fibrinogen, TNF- $\alpha$ , IL-1, IL-6 and IL-8 [7]. The degree of severity of periodontitis correlates positively with the levels of these markers in serum. Recently, apical periodontitis started to be analyzed in the context of its systemic effects. Previously, it had been thought that this was only a local response to dental pulp infected by caries, and that it was associated with secondary bone resorption around the root. It has been shown that the presence of periapical lesions has a significant influence on the whole organism, and the systemic consequences of this chron-

ic disease are very similar to those accompanying chronic marginal periodontitis.

Inchingolo et al. [8] showed that patients suffering from chronic apical periodontitis have an oxidative stress levels which are much higher than those in control groups. This was measured by identification using the reactive oxygen metabolites (d-ROMs) test. Antioxidant status was also measured using the antioxidant potential test (BAP – biological antioxidant potential). An excess of reactive molecules, such as hydrogen peroxide or nitrogen peroxide, leads to a disturbance of the dynamic balance that exists in the body between redox reactions – this condition is called oxidative stress. This is also characteristic of cancerous conditions, ALD and lung diseases. In contrast to studies into the concentration levels of free radicals in the gingival crevicular fluid by protein carbonyl group [9], the (d-ROMs) tests, and (BAP) tests are conducted by analyzing plasma for levels of certain metabolites, which confirms and highlights the systemic nature of the problem. In the case of apical periodontitis, endodontic treatment performed correctly returns the free radical concentration levels in plasma to normal after 90 days. In addition, the level of antioxidant status verified immediately after root canal treatment successively increased, indicating a close and undeniable connection between the redox imbalance and apical periodontitis [8]. This analysis shows there are many similarities in the systemic consequences of both diseases. This is a result of the fact that both diseases are characterized by inflammation caused by bacterial infection and oxidative stress.

Another context of the relationship between chronic periodontitis and periapical changes may result from the influence that the individual bacterial species causing the have on each other. Recently, much attention has been paid to the study of the phenomenon defined as “Polymicrobial synergy”. The virulence of bacteria in the mouth is increased in the case of coexistence, a kind of cooperation between species. Wang et al. [10] conducted a study on this phenomenon and found a very interesting species of bacteria which significantly modify the survival and virulence of other species. This species is named *Filifactor alocis*. Gram positive, asaccharolytic obligatory anaerobic bacteria is detected in both marginal chronic periodontitis and apical periodontitis, as well as periimplantitis. *Filifactor alocis* may modulate host response, so that *Porphyromonas gingivalis* can penetrate into cells by avoiding host defenses. Experiments with sterile mice have demonstrated that *Porphyromonas gingivalis* alone is unable to induce periodontitis. Only the cooperation of both species of

bacteria determines the onset of symptoms of the disease [10, 11]. It is, thus, possible that the coexistence of different species of bacteria, or proteins they produced, can significantly affect the breadth and severity of the changes they provoked. Another example of polymicrobial synergy is the interaction and mutual benefit of living in the common environment of two species of oral bacteria: *Aggregatibacter actinomycetemcomitans* (Aa), a gram negative pathogen, and *Streptococcus gordonii* (Sg), a gram positive commensal bacteria. Aa uses its preferred carbon source, which is the lactate produced by Sg. *Streptococcus gordonii*, produces not only lactate but also hydrogen peroxide (H<sub>2</sub>O<sub>2</sub>), which is potentially harmful to Aa. It has been proved that Aa produces two enzymes allowing it to use the lactate despite the unfavorable environment, i.e. the high concentration of peroxides. These two enzymes are: KatA – this catalase reduces peroxides; and Dyspersyne DspB – this dissolves biofilm Aa and helps it to find the optimum distance relative to Sg, so that the concentration of H<sub>2</sub>O<sub>2</sub> is not too high. This implies that antibacterial substances produced by the commensal flora enhance the virulence of the pathogen by spatial modulation of its location at the site of infection [12]. It is known that communication between the dental pulp and the periodontal tissue may pass through the main channel, additional channels and dentinal tubules. Thus, the bacteria migration characteristic for periodontitis to the pulp, as well as in the opposite direction, i.e. bacterial flow from the infected pulp to periodontal tissue, seems possible [13]. Experience shows that, in the case of small and middle advanced lesions, the direct migration of bacterial flora between the periodontal pocket and the dental pulp occurs very rarely, although the potential for such a method of communication does exist. Bacterial species isolated from periodontal pockets of people suffering from chronic mariginal periodontitis are mainly “Red complex” species: i.e. *Porphyromonas gingivalis*, *Tanarella forsythia*, and *Treponema denticola*. The other species isolated from active periodontal pockets include: *Prevotella intermedia*,

*Campylobacter rectus*, *Eubacterium nodatum*, *Prevotella nigrescens*, *Peptostreptococcus micros*, *Fusobacterium nucleatum*, *Eikenella corrodens*. In the case of apical periodontitis species include: *Actinomyces sp.* and *Propionibacterium propionicum*. However, bacterial flora differs depending on the location and type of apical lesion. In addition, the following have been isolated: *Enterococcus faecium* (36%), *Streptococcus epidermidis* (36%), *Eubacterium saburreum* (28%), *Parvimonas micra* (28%), *Streptococcus sanguis* (28%), *Capnocytophaga sputigena* (28%), *Leptotrichia buccalis* (28%), *Enterococcus faecalis* (28%), and *Staphylococcus warneri* (28%) [14, 15].

Chronic marginal periodontitis and apical periodontitis have many similar features. This similarity concerns both the systemic and local effects of the diseases. Potential routes of communication between periodontal pockets and dental pulp are obvious and well-known. So, it is striking that so many authors dispute the impact of periodontitis on the condition of the living dental pulp. Clinicians are moving away from prophylactic endodontic treatment in the course of periodontitis. A lot of clinical cases presented in the literature demonstrate a spectacular regeneration of periodontal tissues without endodontic treatment. Perhaps the answer to this issue is the specific structure of the pulp. Dental pulp is characterized by sophisticated vascularization. This includes a system of pre-capillary sphincters and arterio-venous connections, and a highly effective lymphatic system, and as is increasingly emphasized, its capacity for regeneration and repair [16]. Regenerative endodontics, using the unique properties of the pulp, as well as stem cells isolated from it, offers the possibility for a conceptual change in dental treatment. Bioengineering, biotechnology and genetic engineering are the areas believed to be the future of modern dentistry [17]. Perhaps, the as yet not fully explored properties of the pulp, its regenerative potential and capacity for repair constitute diagnostic and therapeutic complexities that produce concurrent infections and marginal apical periodontitis.

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