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Editorial

Saliva biotechnology as a diagnostic tool for periodontal diseases: new challenges for clinical practice

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Abstract

The periodontal apparatus has an essential function for the entire stomatognathic system, especially in dental support and in protecting the biofilm from periodontal pathogenic bacteria. Specifically, interactions with the immune system and the surrounding oral environment make it key in the mechanism of aetiology of periodontitis. In the oral cavity, saliva and crevicular fluid have significant functions including oral hygiene and protection of the oral cavity with specific antibacterial effects, on digestion and as a source of early diagnosis of oral diseases. This editorial aims to analyze current knowledge and new challenges on the benefits of saliva as a diagnostic fluid for the early diagnosis of periodontal disease.

Keywords: Periodontitis; Saliva; Biotechnology; Oral health

There has been an increasing interest in science for research on oral biofilm with interconnections on bioengineering and biotechnology in the last decade. It appears increasingly clear how dental research aims towards an even more translational field with the fields of biomedicine and biotechnology in order to obtain advancement in the early diagnostic research of oral and systemic diseases connected to them that can allow achieving rapid results on large slices of the population in the different continents.

The periodontal ligament protects the host from the invasion of pathogenic microorganisms of the biofilm, it contains a highly elaborated immune system that allows an optimal physiological and inflammatory response even in case of the presence of heavy antigen load. Through the oral mucosa, saliva, and periodontal ligament, the development of an effective defence system takes place in constant communication with the various bacterial communities linked in the form of the oral microbiome, whose homeostasis is fundamental for the development of various pathologies of the oral cavity [1,2].

Saliva and crevicular gingival fluid are fluids secreted by the oral cavity and have multiple functions, including anti-plaque effects, self-cleansing of the mucous membranes and early diagnosis of oral diseases [3,4]. Saliva is made up of 99% water and the rest of various organic molecules such as salivary amylase, mucopolysaccharide, lysozymes and various protein mediators such as metalloproteases, cytokines and microRNAs with multiple diagnostic functions useful in predictive medicine. More specifically, saliva is a hypotonic solution produced by salivary acini, which associated with gingival crevicular fluid represents an important carrier fluid of various biomolecular mediators [5]. About 90% of saliva in humans is secreted by the salivary glands, including the parotid, supra and submandibular glands [4–6]. In this regard, it is clear that saliva production is closely linked to systemic and local inflammatory phenomena.

Above all, saliva is considered a potential carrier of biological, biochemical markers, of DNA, in RNA linked to the structure of the valuable microbiota for early diagnosis [5,6].

Periodontitis is a multifactorial pathology with bacterial aetiology that represents one of the most widespread chronic inflammatory diseases in the world, with an incidence of 50% [7]. The progression of periodontitis is usually subclinical with a progressive and increasingly extensive damage to the hard and soft supporting tissues of the tooth, which leads to tooth loss if not properly treated. For this reason, periodontitis requires early diagnosis and close long-term monitoring. However, the traditional clinical diagnostic methods used universally are highly complex, specialized and expensive, and cannot allow an early diagnosis of the disease, especially if reported on large population samples. Recently, with the development of biotechnologies that have analyzed the main inflammatory mediators involved in periodontitis, progress has been made in the development of various salivary platforms with profiles of diagnostic markers useful for the diagnosis and monitoring of periodontitis [8,9].

Recently, some studies have shown how specific kits are used to collect and analyse salivary levels of Porphyromonas gingivalis (one of the most pathogenic bacteria linked to periodontitis) enzyme-linked immunosorbent tests, which were very useful in detecting this bacterium in saliva. These kits are able to detect both laboratory and clinical isolates of P. gingivalis, with high levels of ability [8].

such as to obtain a sensitivity level of 92% and a specificity of 96%, with however differences between studies based on the type of collection kit used. Therefore, the P. gingivalis saliva kit could represent in the future a diagnostic tool to be used routinely in the chair with ease and efficiency in terms of quality and time. Several recent studies have also revealed the good ability of both saliva and gingival crevicular fluid for the analysis of adrenomedullin (AM) and nitric oxide (NO) levels in patients with gingivitis, aggressive periodontitis and periodontitis such as to allow a analysis of the redox profile of these patients, especially when compared to healthy controls [10]. In this regard, patients with periodontitis, in its various forms, showed significantly elevated levels of NO salivary and crevicular fluid, identifying a specific risk of oxidative and cardiovascular stress [11].

Data from another study showed that NO levels analyzed in saliva are more accurate than data from crevicular fluid, but both fluids proved reliable in the assessment. At the same time, the assessment of superoxide dismutase levels, a key mediator in the evolution of periodontal disease in smoking patients; such research has shown a close correlation between superoxide dismutase levels, gingival index, pocket depth and loss of clinical attachment in patients with periodontitis [12].

In addition, levels of pro-inflammatory cytokines and salivary macrophages, matrix metalloproteinases-8, interleukin (IL) -1β, IL-6, prostaglandin E2, and tumor necrosis factor (TNF) -α showed the potential for saliva for early diagnosis in patients with gingivitis and periodontitis [13,14]. Furthermore, salivary levels of Toll-like receptors -4, IL-18, uric acid, aspartate transaminase and procalcitonin in patients with periodontitis have been shown to be elevated already in the early stages of disease compared to healthy patients, showing positive correlations with probing depth, clinical attachment level and gingival bleeding, with reliable data for diagnosis of periodontal disease [15–17].

In recent years, the advantages of saliva as a diagnostic fluid have proven to be highly reliable and repeatable, especially due to the easy ability to collect, store and analyze high-quality early disease, such as to make salivary diagnostics fully enter into precision medicine. Above all, as a reliable alternative to plasma analyzes, developing the concept of salivaomics, the science of early salivary analysis of disease biomarkers and potential drug targets.

However, at present, research on saliva and its applications for the diagnosis of diseases is still in its infancy and progress in this area is still limited by the lack of effective and time-repeatable methods and techniques, as saliva it still has the limit of circadian change in composition and is strongly influenced by external stimuli related to diet or environmental habits. There is, therefore a future need to develop standardized salivary molecular identification systems. For this reason, salivaomics is still in a phase of clear expansion in the field of translation research in order to better understand the role of salivary expression in the correlations between oral health and systemic health, which will promote, in the coming years, the application precision medicine routine by facilitating the identification of targeted and highly predictable medical therapies for patients.

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