Materials Used for Diagnostic and Treatments in Dental Practice

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Oral disease diagnostic research are moving toward methods whereby endodontic, periodontal or peri-implantitis risk can be identified and quantified by biomarkers. Monitoring of endodontic treatment of chronic periapical lesions can be performed using ELISA test to detect levels of MMP-8 and IL-1β in periapical exudates. Early detection of periodontal disease and monitoring of treatment can be performed using microbiological tests, immunological tests and biochemical tests to assess levels of gingival crevicular fluid (GCF), ASAT, MMP-8, MMP-9, IL-1β. Early detection of peri-implantitis and monitoring of therapy outcome can be performed using ELISA test.

Keywords: microbiological tests, immunological tests, biochemical tests, periapical exudates, biomarkers

In dental medicine the traditional diagnostic tools, despite of their ease of use, cost-effectiveness, and noninvasive features, are limited to the assessment of disease history and not current disease status. Oral disease diagnostic research are moving toward methods whereby endodontic, periodontal or peri-implantitis risk can be identified and quantified by biomarkers [1-5].

Biomarkers of a certain disease, including dental diseases, play important roles in diagnosis, monitoring of therapy results, and drug discovery. The challenge is that use of biomarkers to allow earlier detection of disease evolution and therapy efficacy assessment. To be introduced in routine practice, it is essential to be fully understood the relation of biomarkers with the mechanism of disease progression and therapeutic intervention [6].

The aims of this paper are to present current issues biomarkers involvement in the diagnosis and monitoring of results in various dental treatments.

Biomarkers used in treatment of chronic periapical lesions

The presence of chronic periapical lesions implies the complex interactions between bacteria, their products, and the immunological host components. The immunological reaction despite their role in the prevention of infection spreading in bone tissues, also presents a destructive effect for the host tissues. Dental practice requires the diagnostic materials and techniques able to assess the results of therapy and to predict the future evolution of periapical lesions.

Application of molecular genetic methods (PCR techniques) to the analysis of the bacterial diversity in the oral cavity has revealed a still broader spectrum of extant bacteria than previously reported by cultivation approaches [7]. Diagnostic techniques at molecular level (PCR) are important for the detection of some pathogenic species that cannot be cultivated as to obtain positive results on long term. Biological molecular techniques (PCR) are considered most efficient due to speed, accuracy and specificity.

Metaloproteinases are enzymes implicated in the degradation of organic component of periapical tissues and are secreted by PMN, monocytes and macrophages. The endodontic treatments that reduce levels of bacteria inside endodontic space also reduce the active forms of MMP-8 in periapical area. The assessment of IL-1β levels in periapical exudate can also be considered as a method to assess the intensity of periapical inflammatory process. High levels of IL-1β are characteristic to the fluid present inside radicular chist [8]. Ataonlu T. and colab., in 2002, found levels of IL-1β three times higher for teeth with apical secretion comparing with teeth without periapical secretion [9]. On the other way, protective factors can be assessed during therapy; for example, in an alkaline environment created by Ca(OH)2, inactive TGF-β1 is transformed in active growth factor and represents a biomarker of periapical healing processes [10].

Wahlgren J. et al., in 2002 [11], using ELISA test, found a significant reduction of MMP-8 in 10 cases, in a study performed on 11 teeth with chronic periapical lesions treated with Ca(OH)2. Same authors concluded that MMP-8 must be used as biomarker to indicate the therapeutic efficiency in the case of teeth with periapical lesions [1-5].

Tests used in the detection of early periodontal diseases and therapy monitoring

The aim of periodontal diagnostic procedures is to provide useful information to the clinician regarding the periodontal disease category, severity and location. These data serve as a background for treatment planning and are essential during periodontal maintenance and disease-monitoring phases of treatment. The diagnostic tests based on periodontal markers are introduced in dental practice to compensate the diagnostic conventional methods that require significant clinical changes to detect the presence of early periodontal disease. More, the complex nature of periodontal disease requires the use of combinations of host markers. The markers of periodontal disease are as follows: prostaglandines (role in the initiation of inflammatory processes), alcalin phosphatases (biomarkers of osteolytic processes), catepsine B (role in proteolysis of periodontal tissues), colagenases (MMP-8, MMP-9, MMP-13). The colagenases are considered key factors of periodontal disease due to their implication in the destruction of organic component [12]. The roles of diagnostic tests based on biological markers are as follows: the identification of therapeutic objectives, the high risk sites, the monitoring of response to the therapy.

The background of diagnostic tests is related to the microbiological and biological activity criteria of periodontal

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ELISA test in the detection, prevention and treatment of early peri-implantitis

Biomarkers have the potential in detecting early peri-implantitis diseases [21]. IL-1β levels can be a good marker to detect peri-implant mucositis lesions before the initiation of peri-implantitis. MMP-8 levels detected in peri-implant sulcus fluid can be used for monitoring the progression of peri-implantitis. Osteoprotegerin (OPG) and receptor activator of NF-κB ligand (RANKL) are significantly higher in peri-implantitis areas compared with healthy implant areas. The review of Javed F. et al. in 2011 [22] found literature data showing high levels of interleukin IL-1β, IL-6, IL-8, MMP-1, TNF-α in the crevicular fluid of implants affected by peri-implantitis compared to healthy sites. Some studies showed that biomarkers can differentiate healthy peri-implant tissue from mucositis and peri-implantitis sites. Accordingly to Rakic M. et al., [23] levels of biomarkers sRANKL, RANK, OPG, are associated with peri-implant tissue destruction. The authors collected peri-implant/gingival crevicular fluid samples from patients with peri-implantitis, healthy peri-implant tissues, severe chronic periodontitis, and assessed biomarkers levels using enzyme-linked immunosorbent assays (ELISA test). When comparing peri-implantitis and periodontitis findings, RANK was significantly higher in peri-implantitis sites whereas, sRANKL were significantly higher in periodontitis sites. In implant patients pocket depths and bleeding on probing values were positively associated with high RANK levels. RANK was higher in periodontitis sites comparing with healthy peri-implant tissues. Considering these results, RANK can be considered as a pathologic determinant of peri-implantitis, and a potential parameter in assessment of peri-implant tissue inflammation. Also RANK can be considered as a potential biomarker used to design the treatment strategies. In another study, levels of RANK, sRANKL and OPG were significantly increased in patients with peri-implantitis compared with patients with healthy peri-implant tissues, while significantly increased levels of RANK in patients with mucositis comparing with patients with healthy peri-implant tissues [24].

Conclusions

The microbiological, immunological and biochemical tests can be used efficiently to identify early stages of endodontic diseases, periodontal diseases and peri-implantitis. The results of therapy can also be recorded in an objective manner using these tests at specific time intervals.

Application of molecular genetic methods to the analysis of the bacterial diversity in the oral cavity has revealed a still broader spectrum of extant bacteria than previously reported by cultivation approaches. Diagnostic techniques at molecular level are important for the detection of some pathogenic species that cannot be cultivated as to obtain positive results on long term. Also, biological molecular techniques are considered most efficient due to speed, accuracy and specificity.

Among the salivary biomarkers (IL-1β, MMP-8 and MMP-9) demonstrated the highest correlation with diseases status. The detection of MMP-8 using ELISA test in crevicular fluid can be the background of a diagnostic instrument for the assessment of efficiency of periodontal therapy. Other biomarker is RANK which is considered as a pathologic determinant of peri-implantitis, and a potential parameter in assessment of peri-implant tissue inflammation. Also RANK can be considered as a potential biomarker used to design the treatment strategies.

References

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