



The Importance Of Biophysical Methods In Dentistry

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Abstract

The shape and relief of the alveolar ridge play a crucial practical role in the successful use of dental prostheses. For effective prosthodontic treatment, alveolar ridges with a truncated cone or semi-oval shape are considered more favorable. In such configurations, masticatory pressure is distributed over a limited area at the ridge crest and gradually transferred to the broader base of the alveolar process. In contrast, triangular, sharp-edged, or irregularly shaped ridges are highly unfavorable, as they often lead to trauma of the overlying mucosal tissues. Patients with such ridge forms frequently complain of persistent pain and discomfort during prosthesis wear.

Keywords: Palpation, Percussion, Probing, Stomatocopy, Luminescent stomatocopy, Laser Doppler flowmetry, Rheography, Photoplethysmography, Polarography, Echoosteometry, Radiographic examination methods, Tomography, Computed tomography, Radiovisiography.

Introduction

Palpation is of great clinical significance in the examination of the oral cavity before the placement of removable dentures. By palpating the edentulous alveolar ridges, the presence of sharp bony protrusions or exostoses can be identified, as well as mucosal thickness, tissue mobility, and the angulation of the alveolar crest [1].

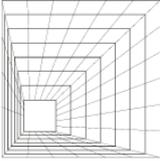
In addition to physical examination methods, a range of instrumental and device-based diagnostic techniques are employed in dental practice: percussion, measurement of tooth mobility using instruments, thermometry, electrometry, radiography, and others [2].

Percussion is frequently used in the diagnosis of acute and chronic periodontitis. A gentle tap is applied to the tooth being examined using a dental probe, tweezers, or a similar instrument. Pain upon horizontal tapping is typically indicative of trauma-induced marginal periodontal damage, such as from an overhanging filling, an ill-fitting prosthetic crown, a fractured edge of a natural tooth, or misaligned clasps on removable dentures [3]. Vertical percussion pain, on the other hand, often suggests the presence of chronic apical inflammation or exacerbation of a periapical lesion [4].

Probing is used to directly assess the condition of the periodontium based on the status of the periodontal sulcus. The presence and depth of periodontal pockets are evaluated with a periodontal probe (as shown in Figs. 60–65), which must have a blunt tip and evenly spaced markings (0.5–1 mm apart) on the surface [5]. The probe is gently inserted into the gingival sulcus on four aspects: vestibular, oral, and both proximal sides. If the probe penetrates 1 mm without resistance, this is considered within normal limits, indicating the absence of pathological pockets [6].

In the absence of a dedicated periodontometer, measurement may be carried out using a blunt probe, the dull end of a Müller needle, or a plastic, gutta-percha, or paper point [7]. Probing is also useful for detecting gingival recession and subgingival calculus in the progressive stages of various periodontal diseases.

Stomatocopy is a method of visual examination of the teeth and mucous membrane using instruments such as a stomatoscope, photodiagnoscope, or visiograph. It allows magnified



inspection and the detection of subtle pathological changes in the oral mucosa [8].

Luminescent stomatoscopy is based on the fluorescence of hard dental tissues when exposed to ultraviolet light. The procedure involves directing UV light beams onto the dried surface of the tooth in a dark room. Healthy enamel fluoresces blue, while areas of initial caries appear as darkened spots due to decreased fluorescence contrast [9].

Electroodontometry (EOM) assesses the condition of the pulp and periodontium by determining the electrical excitability of the pulp nerves. A special testing device delivers an increasing electrical current to the pulp until a minimal sensory response or pain occurs [10]. According to L.R. Rubinov, the normal excitability threshold for healthy pulp ranges from 2 to 6 μA , while inflamed pulp responds at higher thresholds between 20 and 40 μA [11].

Galvanometry evaluates the presence of galvanic currents in the oral cavity due to the use of different metals and alloys in dental fillings and prostheses. Saliva acts as an electrolyte, while metal surfaces function as electrodes. Due to potential differences, galvanic currents ranging from 0.5 to 75 mV may be generated, causing discomfort or electrochemical irritation [12].

The degree of pathological tooth mobility is measured instrumentally using the *Periotest* device, which consists of a portable analyzer unit, powered by a battery, and connected to a flexible probe [13]. The mobility index is interpreted as follows:

- Grade 0: from -08 to +09,
- Grade 1: from -10 to +19,
- Grade 2: from -20 to +29,
- Grade 3: from -30 to +50.

Percussion of covered teeth is performed at the mid-vestibular surface using the probe tip held 0.5–2.5 mm from the crown surface at a right angle [14].

The conducted clinical assessments confirm that biophysical diagnostic methods in dentistry are highly valuable for evaluating the functional and morphological state of the oral cavity. Each method offers a unique diagnostic capability depending on the tissue involved and the specific purpose of the investigation.

For example, laser Doppler flowmetry (LDF) is effective in measuring microcirculatory blood flow in periodontal tissues. The method is based on the Doppler effect produced by laser light reflected off moving erythrocytes, allowing for the assessment of tissue perfusion and vascular reactivity with high sensitivity [13]. The device "LAKK-01" is commonly used for this purpose, and it allows real-time data acquisition through optical fiber probes placed on the gingival surface [14].

Similarly, ultrasound Doppler sonography enables the non-invasive assessment of blood flow through hard and soft tissues of the jaw. This technique is particularly helpful in detecting vascular abnormalities or reduced perfusion in chronic inflammatory processes [15].

Rheography, including modifications such as reodontography and reoparodontography, offers quantitative analysis of vascular tone by recording electrical resistance in tissues. It objectively reflects the pulse wave propagation and is useful for evaluating circulatory efficiency in teeth, gums, and temporomandibular joints [16].

Photoplethysmography (PPG), though related to rheography, measures optical density changes in tissues caused by variations in blood volume. Based on densitometry principles, this method offers a precise assessment of gingival microcirculation, particularly valuable in early diagnosis of periodontal disease [17].

The polarographic method (PG) measures oxygen tension in tissues, providing a functional evaluation of hypoxia. This electrochemical technique registers current changes relative to oxygen concentration in periodontal, facial skin, or grafted tissues and is particularly valuable in determining the severity of ischemic damage [18].

In terms of bone diagnostics, echoosteometry evaluates the thickness and density of jawbone



structures by measuring the time required for ultrasound waves to pass through bone. This method is effective in detecting early stages of osteoporosis, especially in the mandibular body where proper sensor placement is possible [19].

Radiological examination methods remain the gold standard for structural visualization of oral tissues. Intraoral radiographs (contact and bitewing techniques) are preferred for detailed imaging of root structures and adjacent bone. Tomographic imaging, including panoramic radiography, electroradiography, and cone-beam computed tomography (CBCT), provides 3D visualization of anatomical layers without the superimposition of surrounding shadows [20].

Contrast radiography, such as sialography and angiography, adds further diagnostic capacity by visualizing salivary ducts and vascular systems using iodine-based contrast media. These techniques are crucial in detecting obstructions, inflammations, and salivary stones [21].

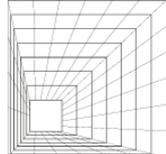
Finally, radiovisiography (RVG) enables the digital acquisition and processing of radiographic images. With enhanced contrast, resolution, and reduced radiation dose, this method is highly suitable for both diagnostics and treatment planning. Advanced features such as zooming, edge detection, and grayscale inversion make RVG an indispensable tool in modern dental practice [22].

Conclusion

Biophysical diagnostic methods have become increasingly important in dentistry due to their objectivity, non-invasiveness, and ability to provide valuable quantitative data on periodontal, pulpal, and bone tissue conditions. The accurate assessment of alveolar crest shape, mucosal thickness, and tissue perfusion allows clinicians to determine the appropriateness of prosthetic interventions, especially removable dentures. Techniques such as palpation, percussion, probing, stomatoscopy, electroodontometry, laser Doppler flowmetry, rheography, photoplethysmography, and radiovisiography provide insight into tissue vitality, vascular function, and anatomical integrity. Advanced radiological techniques such as tomography and computed tomography further enhance diagnostic precision. The application of these methods contributes to improved clinical outcomes, reduced patient discomfort, and prolonged prosthesis service life. Integration of multiple biophysical tools offers a comprehensive, evidence-based approach to modern dental diagnostics and prosthodontic planning.

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