Review shows effectiveness of pulse oximetry in pulp vitality testing

Iran
Dr Hamid Jafarzadeh from the Faculty of Dentistry and Dental Research Center at Mashhad University of Medical Sciences and Professor Paul A. Rosenberg (Department of Endodontics, New York University College of Dentistry, USA) recently conducted a comprehensive review of the potential of pulse oximetry in endodontic diagnostics. The study aimed to encourage dentists to use this system and to be familiar with various aspects of its application.

“All dentists know that for determining the vitality of a pulp, the ideal tests used should be objective, painless, and reliable. The most common tests for this purpose are sensibility tests; however, a major limitation of these tests is that they subjectively imply vitality through sensory responses,” explained Dr Jafarzadeh. One alternative method, that evaluates pulp vascularity, is pulse oximetry.

“We searched the literature on pulse oximetry in the context of endodontics up to March 2008 using different medical databases and provided a review on Principles, Indications, Limitations, Influencing Factors, Variations in Probe Design for Dental Usage, and Value of the Test,” Jafarzadeh added.

The challenge of the study was that no commercial unit appropriate for endodontics exists at this time. Moreover, because of some difficulties, application of this system is not routine in dentistry, especially in endodontics. “Pulse oximetry is an effective, objective oxygen saturation monitoring technique broadly used in medicine for recording blood oxygen saturation levels. It applies a principle known as the Beer-Lambert law, which states that an unknown concentration of solute (hemoglobin) dissolved in a known solvent (blood) can be assessed by the light absorption of the solute. Absorption of red and infrared light by vital teeth varies in phase with the cardiac cycle, but has smaller amplitude,” he explained.

He believes pulse oximetry may be useful in the differential diagnosis of vital pulps and necrotic ones. An important advantage is that the test produces no noxious stimuli so apprehensive or distressed patients may accept it more readily than routine methods. “Light is passed from a photoelectric diode across the tooth structure into a receptor and the instrument detects changes in absorption in both red and infrared light caused by alteration in tissue volume (tissue perfusion) during the cardiac cycle. However, there are some limitations inherent in the technology of pulse oximetry, such as the effect of increased acidity and metabolic rate which cause deoxygenating of hemoglobin and changes in the blood oxygen saturation,” he said. Additionally, movements of the body or probe can complicate readings.

“The pulsatile change in the blood volume causes periodic changes in the amount of red and infrared light absorbed by the vascular bed before reaching the detector. The relationship between the pulsatile change in the absorption of red light and infrared light is assessed by the oximeter to show the saturation of arterial blood. It uses this information, together with known absorption curves for oxygenated and deoxygenated hemoglobin, to determine the oxygen saturation levels. By monitoring changes in oxygen saturation, pulse oximetry may be able to detect pulpal inflammation or partial necrosis in teeth that are still responding sensibly to other tests,” he explained.

According to Jafarzadeh, should commercial units be manufactured for this purpose, they should be small and affordable, and thus more applicable for endodontic use. Some studies have reported more successful use of this system and others have not, but along with decreasing costs and more experience with these systems, the use of pulse oximetry in routine clinical endodontic practice in the future is increasingly likely. An effort to manufacture an adaptable sensor for the teeth would be helpful,” he added. Going forward Jafarzadeh is planning to conduct a survey about the usage of pulse oximetry in endodontics with the help of the American Board of Endodontics.