

# Pulp Testing -Implication And Advances Pulp Testing

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**ABSTRACT:** *One of the greatest challenges to the clinicians is the accurate diagnosis and evaluation of the pulp status. Pulp sensibility tests [thermal and electric tests] interpret status of pulp health from sensory response. Though it is the most commonly used test in clinical practice, recent studies have shown that blood circulation is the most accurate determinant in assessing pulp vitality as it provides an objective differentiation between the vital and non-vital pulp tissue. Examples of vitality tests include Laser Doppler flowmetry and pulse oximetry. Although the results are promising with these tests, in order to replace sensibility tests as the standard clinical pulp diagnostic test, practical issues of pulp vitality tests need to be addressed. The aim of this review is to provide the clinician a thorough knowledge and understanding of various pulp testing and its indications. The results of any pulp test have to be interpreted carefully, as false results can lead to misdiagnosis and ultimately inappropriate, or unnecessary treatment.*

**Key words:** *Pulp testing, Laser Doppler Flowmetry, pulp vitality, pulp diagnosis*

## 1. INTRODUCTION

The main aim of diagnosis is to find out the root cause of the problem. Hence, pulp testing together with the information obtained from history, examination, and other investigations is necessary to arrive at the diagnosis of any underlying pathosis<sup>(1)</sup>. Pulp testing is an important

aid in the assessment of pulp disease and apical periodontitis<sup>[2]</sup>. Currently all pulp testing methods have their own limitations, especially in terms of accuracy, reliability, and reproducibility from a technical point of view. Moreover, correct implication is important, as not all pulp testing agents are appropriate for all clinical situations. The value of pulp testing is acknowledged from identifying the pulpal pain from other conditions such as myofascial pain dysfunction syndrome and referred pain<sup>[3]</sup>. Contrarily, a normal response to pulp testing eliminates pulpal pathology in the diagnosis of oro-facial pain of unknown etiology. Vitality testing plays an important part in the review of recently traumatized tooth<sup>[4]</sup>. According to Grossman, pulp testers can also be used to assess whether the tooth is completely anaesthetized following administration of local anesthetics<sup>[5]</sup>. The aim of this review is to provide the clinician a thorough understanding of various pulp testing methods and their indications.

## **RATIONALE OF PULP TESTING**

Pulp testing is usually done prior to restorative, endodontic, and orthodontic procedures to assess the state of the pulp, for monitoring the pulp after trauma and to exclude differential diagnosis<sup>[6]</sup>.

## **PULP ASSESSMENT METHODS**

The most reliable way of evaluating the pulpal status is by the histological examination of the tissue specimen involved. Unfortunately, in clinical situations these are neither impractical and feasible; hence dentist must use investigations like pulpal tests to supply additionally diagnostic information<sup>[7]</sup>. The ideal objective of pulp testing methods is to provide a reproducible, non-painful and inexpensive way to evaluate the condition of the pulp tissue. Pulp testing strategies involve sensibility tests such as thermal or electric pulp testing (EPT) which is based on the sensory response. These methods are most commonly used by the clinicians. The other form of pulp testing is to evaluate the vascular supply of the tooth using laser Doppler flowmetry (LDF) or pulse oximetry. Hence these methods are termed as pulp vitality tests<sup>[8]</sup>.

## **PULP SENSIBILITY TESTS**

The term sensibility is because of its ability to respond to a stimulus, and hence this can be an accurate and appropriate term for the standard and most regular clinical pulp tests like thermal and electrical tests provided they neither assess the pulp's blood supply nor its capacity to live, grow or develop<sup>[9]</sup>. These tests check the integrity of the A $\delta$  nerve fibers in the dentine-pulp complex by directly applying a stimulus to the external surface of the tooth. If the A $\delta$  nerve fibres are stimulated successfully, the subjective response will be of a short, sharp sensation/tingling sensation<sup>[10]</sup>.

1. The pulp is deemed normal when there's a response to the stimulus caused by the sensibility test and this response isn't pronounced and it doesn't linger.
2. Pulpitis is present when there's a different response that causes pain. Pulpitis will be considered as reversible or irreversible, counting on the severity of pain and whether the pain lingers or not. Typically mild pain of short duration is taken into account to point reversible pulpitis while severe pain that lingers indicates irreversible pulpitis.
3. The absence of responses to sensibility tests is sometimes related to the pulp necrosis, the tooth is non vital, or has had previous passageway treatment.
- 4 False negative response – tooth shows no response even in vital pulp in conditions like - recently erupted tooth with open or immature apex. Recent trauma to the tooth resulting in lack of nerve supply at the apical foramen or presence of inflammatory exudates surrounds

the apex of the tooth which interferes with the nerve function. It's also seen in calcifications of the pulp which interferes within the nerve conduction.

5. False positive response - a non-vital tooth appears to respond positively to testing. Necrotic multi rooted teeth, can conduct electric currents via viable nerve tissue in adjacent areas, thereby resulting in a false positive result which can interfere with the diagnosis as well as the treatment.

After completion of root canal treatment, if the patient experience sensitivity in a tooth, the clinician should think of an extra root or canal<sup>[11]</sup>.

### **PULP SENSITIVITY**

Some practioners still use the term sensitivity tests instead of sensibility. Sensitivity is the state of being easily irritated. A pulp which responds to stimulus is actually displaying sensibility, but the response may be irritational or annoying in a case where inflammation is present. It is the response that differs but the tests is still the same<sup>[12]</sup>.

### **PULP VITALITY TESTS**

Vitality is defined as the ability to live, grow or develop. In dentistry, vitality implies to the viable blood supply to the pulp. Unfortunately these tests are not being used in regular clinical practice due to its time consuming procedure and cost provided they do not reproduce the symptoms<sup>[13]</sup>.

### **LASER DOPPLER FLOWMETRY**

Pulp vitality implies that blood supply is always present within the tissue surfaces hence the test that correctly measures pulp blood flow is called a vitality test. Laser Doppler Flowmetry (LDF) allows the semi-quantitative recording of blood flow. The technique uses a beam of infrared light directed into the tissue. As light enters, it gets scattered and adsorbed by moving red blood cells causing the photons to get frequently shifted according to the Doppler principle. Photons that interact with the tissue elements are scattered but are not Doppler shifted. A portion of the light is returned back to the photon detector, and a signal is produced. Since, red blood cells make up the vast majority of moving objects, backscattered light is interpreted as an index of pulpal blood flow<sup>[14]</sup>.

### **INDICATIONS**

1. Estimation of the pulpal vitality: the diagnosis of a tooth with a necrotic pulp could also be difficult particularly when pain is present. In these situations, an appropriate test and its precise interpretation are of paramount importance
2. Pulp-testing in children: sensibility tests aren't reliable in children, because they're subjective and depend on patient's response. LDF may be a suitable technique for the measurement of PBF in deciduous incisors tooth<sup>[15]</sup>.

### **ADVANTAGES OF LDF**

Laser dopplerflowmetry(LDF) can differentiate between healthy and non-vital teeth. Furthermore, LDF readings have proved to be accurate in determining vitality following revascularization. LDF for human teeth should be performed at 4 weeks following the initial trauma and at regular intervals to assess the vitality. It is useful in young children whose responses are unreliable and its noninvasive nature helps to push patient cooperation and acceptance.

## LIMITATIONS

Artefact is produced due to uncontrolled movement of the probe and hence the sensor should be maintained motionless and in constant contact with the tooth for proper readings. Modified mouthguard or splint can also be used to stabilize the measuring probe to obtain more precise readings. Blood pigments can also interfere with laser light transmission. The beam of light must contact with the moving cells within the pulpal vasculature<sup>[16]</sup>.

## PULSE OXIMETRY

Pulse oximetry has recently been adapted for use in dentistry practice. This technique has been the most regularly used technique for the measurement of oxygen saturation in medicine because of its ease and affordability. Pulse oximetry is an entirely objective test, which doesn't requiring any subjective response from the patient. The pulse oximeter sensor has two light-emitting diodes, one diode is to transmit red light (640 nm) and the other light is to transmit infrared light (940 nm). And on the opposite side of the vascular bed photo detector is present. Oxygenated and also the deoxygenated hemoglobin absorbs different amounts of red/infrared light the pulsatile change in the blood volume and it also causes periodic changes in the amount of red infrared light absorbed by the vascular bed prior to reaching the photo detectors. The relation between the pulsatile change in the absorption of red light and the pulsatile change in the absorption of infrared light is analyzed by the pulseoximeter to detect the saturation of arterial blood. They recommended its uses as a definitive pulp vitality tests<sup>[17]</sup>.

## DUAL WAVELENGTH SPECTROMETRY

Dual wavelength spectrophotometry (DWLS) is the technique independent of a pulsatile rotation. Within a very short time interval continuous spectrophotometric readings are taken at the beginning of the replantation and 1 month later revealed an increase in blood oxygenation levels indicating a healing process and that the pulp of the exact tooth was recovering. Hence endodontic treatment need not be taken. It uses the visible light that is filtered and guided to the tooth by fibro optics. Thus unlike laser light, added eye protection is not necessary for the patients and also for the operators. Further vivo tests are needed for their usage in dentistry<sup>[18]</sup>.

## 2. CONCLUSION

An accurate detection of tooth vitality is of paramount importance in dental practice. Diagnosis forms the basis of treatment. Equipping one's natural diagnostic instinct with knowledge of contemporary advances would ensure the clinicians to use proper diagnostic tools in order to provide the reliable treatment to their patients.

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