

Evaluation of Dental Pulp Testing: Simple Literature Review

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Abstract

Background: As a dentist, a variety of tests available to help diagnose or monitor the treatment progress are important to understand in order to provide the best care for patients. One of the tests that can be important in diagnosing some important daily-seen conditions is pulp testing. This test has variable indications and can be performed in variable techniques with different materials. **Objectives:** We aimed to have an overview of the current methods of pulp testing, their interpretation, and newly developed methods. **Method:** PubMed database was used for articles selection, and the following keys used in the MeSH (“Dental Pulp Disease”[MeSH]) AND (“Dental Pulp Testing”[MeSH])). **Conclusion:** The importance of doing these tests is to detect the viability and health of the tissue. This is done after dental trauma and in investigating for dental and oral pathologies. The golden standard of determining the viability is histological slide examination, which helps in the assessment of the grade and extension of inflammation and/or necrosis. Vascular status assessment by Doppler flowmetry is reliable and can be a possible standard in diagnosing pulp vitality. Moreover, pulp oximetry shows accuracy in diagnosing pulp pathologies.

Keywords: Dental pulp, Pulp vitality test, pulse oximetry, Doppler flowmetry, pulpal pathology

INTRODUCTION

As a dentist, a variety of tests available to diagnose or monitor the treatment progress is important to understand, in order to provide the best care for patients. Management and diagnosis can never be made using just one test, but the whole interpretation of clinical clues including history, radiological modalities, and special clinical tests are needed. One of the tests that can be critical in the diagnosis of some important and daily-seen conditions is pulp testing ^[1,2]. These tests have variable indications and can be done in variable techniques (using different materials). Thus, grasping the idea behind tests, different types, and their clinical differences will help to choose the best test for each individual ^[3]. In this paper, we will review relevant papers regarding the main clinical indications, diagnosis, different types, and their clinical role in pulp testing.

METHODOLOGY

PubMed database was used for articles selection, and the following keys used in the mesh (“Dental Pulp Disease”[MeSH]) AND (“Dental Pulp Testing”[MeSH])). In regards to the inclusion criteria, the articles were selected based on the inclusion of one of the following topics; Dental Pulp disease diagnosis and Dental Pulp Testing. The

exclusion criteria were all other articles that did not have one of these topics as their primary endpoint.

DISCUSSION

Dental pulp testing refers to tests done to determine the vitality status of the pulp. Checking this vital status is important in some conditions such as apical periodontitis, endodontic pathologies, periapical pathosis -exclusion-, monitoring and following dental trauma. Moreover, it is done

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to create a clear clinical picture for the dentist to differentiate odontogenic pain from other sources, determine the exact site of pain, and to perform appropriate orthodontic procedures. (major restorative endodontic). The golden standard of determining the vitality status is the histological section examining the tissue; however, this cannot be done unless we take out the pulp. This test helps in determining the grade and extension of inflammation and/or necrosis. However, this test is impractical and usually not feasible in daily practice. Therefore, dental pulp testing is more commonly used to help patients in need. The vitality of dental pulp, like other tissues, is mainly related to the vasculature, and necrosis shows almost no vasculature and some tests try to determine the vasculature status. Some other tests measure this indirectly, such as sensibility tests, which assess the sensory response by introducing a stimulus and detecting -the nerves'- response. These tests indirectly measure the blood supply since the pulp nerves are usually the first to be affected with low vasculature [3].

Pulp Sensibility Tests:

In cases where the pulp is showing hyper-responsiveness to the stimulus introduced, a pulp sensibility test can be done. This is mainly done for patients with suspected pulpitis and/or trauma and is used in the daily clinical setting to reflect the vitality of the pulp [3]. One major aspect is that dental pulp cannot be measured directly because it is enclosed within many calcified tissues, which form a barrier. The main mechanism of these tests is that stimuli will only elicit a response felt by the patient when there is a viable nerve (innervation) and this cannot be sustained unless with blood supply. Another point is that nerve fibers in the pulp show more resistance to necrosis than the vascular tissue, making the negative results of neural function a good reflection of vasculature theoretically. However, these tests cannot specify if the nerve is inflamed or not, since both cases will elicit a "response" and it can be tricky to recognize a hyper response reaction in patients by the dentist.

The main nerve fibers tested are alpha myelinated neurons (axons) and these only exist in the mature tooth (4 to 5 years after the eruption). This is reflective in the rule of sensibility tests in pediatrics and can be false negative in many cases due to the fewer numbers of mature nerves, thus fewer stimuli responses are observed. So, generally, these tests are not as reliable for pediatrics with primary or young permanent teeth, as they do in adults to reflect the vasculature status of the pulp [4]. Another concern when testing is the physician being subjective, since the dentist provides a stimuli and the patient is the one reporting the response, which can be either pain or discomfort. Thus, sometimes the pain threshold of the individual or special populations (like young kids), along with the dentist interpretations of results may make the test being subjective a concern for diagnosis. Another point that the dentist need to keep in mind is that (especially in trauma cases) any damage to the neural component will make this test less reliable. This is seen regularly in recent dental trauma patients where we have a vital pulp vasculature but "non-

vital" results upon tests due to the neural injury. This is why these tests are usually done for monitoring and following up trauma cases rather than just simply "diagnosing" a problem from one setting [5].

Types of Sensibility Tests:

A combination of adequate history with clinical assessment, supplemented by specific pulp tests and X-rays, should summit in an accurate diagnosis. The dentist should look for the signs of impending or overt necrosis, or periodontitis, while also assessing fiber conduction and blood flow to the area. Nerve functionality can be determined through sensibility testing, where the patient responds to tooth stimulation —indicating normal fiber conduction. There are other important aspects that cannot be assessed through sensibility testing alone —mainly blood flow and partial damage. It could be argued that nerves would not function in the absence of adequate oxygenation i.e. blood transport; in comparison, vasculature may remain intact after trauma, while nerves are in fact damaged [6].

The type of tests used are based on the character of the stimuli used, and mainly they are cold, heat, and electrical tests. The main idea behind these thermal and electrical stimuli is their ability to produce a (neuron) response by changing temperature resulting in dentin liquid movement, thus the stimulation of pulp (in thermal tests -heat and cold-). The electrical test produces a response by directly applying an electrical current through the tooth, eliciting an electrical stimulation of the pulp nerves. There are many chemicals used in the thermal tests, most notably carbon dioxide (CO₂), 1,1,1,2-tetrafluoroethane, and dichlorodifluoromethane (DDM). Furthermore, it can be done with simple material as a stick of dry ice, and/or heated gutta-percha stick [7].

Thermal testing invokes sharp sensations and is sharper than the electrical one. Thermal testing can be through cold or hot stimuli, as both are of value in excluding pulp damage, however, cold testing is superior [8]. An irreversibly inflamed pulp is presented with prolonged pain sensation, usually more than thirty seconds. In contrast, dead tissue would not respond to this stimulation and this finding is an indication for endodontic treatment. Misinterpretations of the results may occur, as anxious patients would respond to the stimulation testing higher than others do, even in the absence of an actual sensation. The results could also be clouded by recent trauma (as previously stated), sclerosed canals, incomplete root development and clinical psychotic disorders [9].

Other Pulp Vitality Tests:

Assessing the vitality of pulp is important, especially in cases of inflammation. Anusha *et al.* reported pulse oximetry (PO) as an efficient tool in diagnosing pathologies. False-positive results are reported when patients are anxious, and this finding is frequently seen using laser Doppler flowmetry (LDF) usage. This is based on the concept that vascular supply has the highest accuracy in determining the vital status of pulps [10]. Recent studies reported great accuracy with the

promising effect of laser Doppler flowmetry in determining the blood flow status in the pulp. Alghaithy *et al.* suggested Doppler testing as the gold standard as it had the greatest accuracy in identifying healthy pulps ^[11]. This test introduces a laser light to the tooth, with a detector to measure the signal reflecting the flux blood cells, determining the vasculature status in the pulp. This presents a more objective and reliable measurement of pulp condition and accurate follow up of post-traumatic dental injuries. However, it has some disadvantages hindering its introduction to the daily life of dentists, these include very high cost, technique sensitive, need to use putty splint, and uncontrolled movement of the probe in some situations. Thus, this test is usually done when the available evidences for the dentist from history, radiological modalities and special tests are contradictory and/or insufficient ^[12, 13].

Overall, recent studies have emphasized the rule of pulse oximetry, laser Doppler flowmetry, and ultrasound Doppler flowmetry (other variety of LDF) as the better standard of testing. This was promoted due to deficiency in the studies design and high risk of bias in the articles favoring other sensibility tests. However, better study designs with a larger population are vital to make the clinical approach clear to dentists ^[14].

CONCLUSION

The dentist shall approach the diagnosis of the dental pulp as an integration and interpretation process of the patient as a whole. This includes reviewing all the available data from history, clinical examination, radiology, and special tests (including pulp testing) before deciding on the management. These pulp tests, even if they provide great data, shall not be the only test determining the patient's treatment plan as a whole. Moreover, understanding the differences and concepts of these tests allows the dentist able to select the best test for each patient. Nevertheless, and with all the recent studies about these tests, there is still a need to provide larger clinical studies, especially for the relatively newer modalities for pulp vitality testing such as pulse oxymetry.

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