

## COMPARISON OF ELECTRIC PULP TESTING WITH THERMAL TESTING TO REGISTER PULP VITALITY IN ANTERIOR TEETH

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### ABSTRACT

**Objective:** The aim of this study was to compare the effectiveness of Refrigerant (1,1,1,2-tetra-fluoromethane) (Hygienic endo-ice green [Endo-Ice], Coltene Whaledent, Langenau, Germany) with EPT (Sybron Endo) to check tooth vitality in anterior teeth. As accurate assessment of pulp status with the help of only pain history and radiographs is often a great challenge in clinical practice so a reliable, cost-effective and readily available vitality test must be available in clinical setting to reach a definite diagnosis.

**Materials and Methods:** a consecutive sampling Study, including 121 patients with history of irreversible pulpitis, was done. First a no.2 cotton pellet was sprayed with Endo-Ice, Coltene Whaledent, and placed for approximately 15 seconds or until participant raises a hand to indicate that he or she feels a cold sensation. After a lapse of two minutes, EPT (Sybron Endo) was used to apply electric impulses to the tooth. Once the tests for checking vitality were done, teeth were anesthetized, and access to the chamber was made. The presence of blood in the chamber means tooth is vital, whereas absence of blood means necrosis. Root canal treatment was then performed. SPSS version 11 was used for computation analysis of the data.

**Results:** The study reveals that the effectiveness of Endo-Ice (thermal testing) was more positive diagnosis before initiating root canal treatment as compared to electric pulp test.

**Conclusion:** Inside the confinements of the investigation, it very well may be reasoned that not all dental specialists knew about the dangers they were presented to what's more, just 50% of them watched contamination control rehearses. Moreover, most of them didn't know about appropriate clinic waste management. A substantial extent of the dental specialists were not rehearsing appropriate strategies for social insurance squander transfer. Henceforth there is a need to teach the dental specialists with respect to appropriate processes measures.

**Keywords:** Endo-Ice, Coltene Whaledent, EPT (Sybron Endo), Sensitivity, specificity, positive predictive value, negative predictive value

### INTRODUCTION

In clinical practice, one of the most significant diagnostic challenges is accurate assessment of the status of the pulp.<sup>1</sup> As

The pulp is enclosed within a calcific barrier, direct inspection of the pulpal tissue is not possible before the commencement of endodontic treatment. For this reason, indirect methods must be used to determine pulp vitality.<sup>2</sup> Dental pulp tests are investigations that provide a dental clinician with diagnostic and treatment planning information. These tests are considered to be relatively non-invasive, easy to use and cost-effective.<sup>3</sup> Electric pulp tester excites A-delta fibers in the pulp. If a sensation is felt by the patient, the pulp is assumed to be responsive or at

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least partially vital, when a gradually increasing level of electric current is transmitted through the tooth.<sup>4</sup> Apart from being easy to use, Green Endo-Ice also shows rapid results. A bright A-delta sensation or cold response felt by the patient indicates that part or all of the pulpal tissue is responsive.<sup>5</sup> With each of these tests - cold and electric - the stimulus is applied to a similar region on each tooth, to obtain comparative results. With anterior teeth, the stimulus is usually applied to the labial enamel of the incisal third of the crown.<sup>6</sup>

The current gold standard for determining the actual state of pulpal health is a histological examination of the dental pulp. The implementation of such a gold standard requires the extraction of the tooth shortly after the use of the diagnostic tests and is thus impossible in the majority of cases where sacrificing the tooth is not clinically indicated. Instead, less invasive reference standards, such as direct inspection of the dental pulp, may be used for comparison.<sup>7</sup>

The overall goal of diagnostic testing is twofold. The first is to gain objective data from the patient's signs and symptoms as well as from the results of diagnostic testing. The second is to reproduce the patient's chief complaint if the patient has had past painful episodes. If the chief complaint cannot be reproduced during the evaluation, the practitioner should be wary of providing any treatment that might be well-intentioned but might result in a poor outcome. The outcome of the study was also to determine the diagnostic accuracy of thermal testing and electric pulp testing to register pulp vitality by confirming with presence of blood in the chamber as gold standard in our study. Teeth with history of irreversible pulpitis represent the most commonly reported endodontic cases that give varying pulp vitality test results. Moreover, we can proceed with root canal treatment to confirm our diagnosis in teeth with a history of irreversible pulpitis.

## MATERIALS AND METHODS

A Cross-sectional Validation Study was conducted at the Dental department, Pakistan Institute of Medical Sciences (PIMS) Islamabad, Pakistan. Data were collected by consecutive sampling (non-probability) of 121 Patients between the age groups, 18-60 years (sclerosis excluded) of both sexes reporting to the Dental OPD. Single rooted permanent mandibular and anterior maxillary teeth only with symptoms of irreversible pulpitis were included. Teeth with sclerosed canals, recently traumatized teeth, discolored teeth, teeth with extensive metallic restorations, teeth with full surface crowns, teeth with previously attempted RCT, teeth with root resorption were excluded from the study.

SPSS version 11 was used for computation analysis of the data. Descriptive statistics were calculated. Mean  $\pm$  SD for Quantitative variables like age, tooth number, etc.

Frequency and percentage for Qualitative variables like tooth response on both EPT and thermal testing and True positives.

The approval of the ethical committee was taken, and informed consent was taken from each patient.

After thorough history taking, clinical and radiographic evaluation, each patient was instructed to raise his or her hand the moment he or she feels a cold or tingling sensation during the testing. First a no.2 cotton pellet was sprayed with a refrigerant (1,1,1,2-tetrafluoromethane), Coltene Whaledent, Langenau, Germany) and placed on the labial surface of the crown in the middle 1/3rd for approximately 15 seconds or until participant raises a hand to indicate that he or she feels a cold sensation. After a lapse of two minutes, tooth was isolated with cotton rolls, dried, and then EPT (Sybron Endo) was used to apply electric impulses to the tooth. Teeth responding at a level lower than 80 were considered vital.

A 2x2 table was constructed to determine the following

| Electric pulp tester/<br>thermal testing | Blood in the chamber |                |
|------------------------------------------|----------------------|----------------|
|                                          | +                    | -              |
| +                                        | True positive        | False-positive |
| -                                        | False-negative       | True negative  |

Sensitivity= true positive/true positive + false negative x100

Specificity= true negative/true negative+ false positivex100

Positive predictive value= true positive/true positive + false positivex100

Negative predictive value= true negative/false negative + true negativex100

Patients' responses to both tests were recorded in proforma. Once the tests for checking vitality are done, the tooth was anesthetized using 2 % lidocaine with 1:100,000 epinephrine administered either as local infiltration or inferior alveolar nerve block. After application of a rubber dam, access to the chamber was made, and it was recorded whether or not the pulp is hemorrhagic. The presence of blood in the chamber was indicated vitality, whereas absence of blood was indicated necrosis. Root canal treatment was then performed. Sensitivity, specificity, positive predictive value, negative predictive value was calculated.

## RESULTS

The mean+standard deviation of age (years) in the study was 34.92+12.09 with ranges from 18 to 60 years, as shown in Table. No. 01

Majority of the patients were females, i.e. 65 (53.7) whereas frequency and percentages of male

patients were 56 (46.3), as shown in Table. No. 02

The outcome of the study was to determine the diagnostic accuracy of electric pulp testing to register pulp vitality by confirming with the presence of blood in the chamber as the gold standard in our study. A 2x2 table was constructed in which the diagnostic accuracy of electric pulp testing was 59.50%, where sensitivity, specificity, PPV, and NPV of EPT was 85.18%, 92.5%, 95.83%, 75.51% respectively, as shown in Table. No. 03

Similarity, the outcome of the study was to determine the diagnostic accuracy of thermal testing to register pulp vitality by confirming with the presence of blood in the chamber as a gold standard in our study. A 2x2 table was constructed in which the diagnostic accuracy of thermal testing was 63.63%, where sensitivity, specificity, PPV, and NPV of EPT was 91.35%, 92.5%, 96.10%, 84.09% respectively, as shown in Table. No. 04

**Table 1: Descriptive Statistics of Age (years) of patients number**

|     | <b>n</b> | <b>Mean</b> | <b>Std. Deviation</b> |
|-----|----------|-------------|-----------------------|
| Age | 121      | 34.92       | 12.094                |
| N   | 121      |             |                       |

**Table 2: Gender distribution of patients**

|        | <b>Frequency</b> | <b>Percent</b> | <b>Cumulative Percent</b> |
|--------|------------------|----------------|---------------------------|
| Male   | 56               | 46.3           | 46.3                      |
| Female | 65               | 53.7           | 100.0                     |
| Total  | 121              | 100.0          |                           |

**Table 3: Comparison of Tooth Response on EPT with Blood in the chamber after opening as Gold Standard**

| <b>Tooth Response on EPT</b> | <b>Blood in the chambers after opening</b> |                 | <b>Total</b> |
|------------------------------|--------------------------------------------|-----------------|--------------|
|                              | <b>Positive</b>                            | <b>Negative</b> |              |
| Positive                     | 69                                         | 3               | 72           |
|                              | 85.2 %                                     | 7.5%            | 59.5%        |
| Negative                     | 12                                         | 37              | 49           |
|                              | 14.8%                                      | 92.5%           | 40.5%        |
| Total                        | 81                                         | 40              | 121          |
|                              | 100%                                       | 100%            | 100%         |

Sensitivity (%) : 85.18 %

PPV (%) : 95.83 %

Diagnostic Accuracy : 59.5

Specificity (%)

NPV (%)

: 92.5 %

: 75.51 %

Table 4: Comparison of Tooth Response on Thermal Testing with Blood in the chamber after Opening as Gold Standard

| Tooth response on thermal testing | Blood in the chambers after opening |          | Total  |
|-----------------------------------|-------------------------------------|----------|--------|
|                                   | Positive                            | Negative |        |
| Positive                          | 74                                  | 3        | 77     |
|                                   | 91.4%                               | 7.5%     | 63.6%  |
| Negative                          | 7                                   | 37       | 44     |
|                                   | 8.6%                                | 92.5%    | 36.4%  |
| Total                             | 81                                  | 40       | 121    |
|                                   | 100.0%                              | 100.0%   | 100.0% |

Sensitivity (%) : 91.35 %

Specificity (%) : 92.5 %

PPV (%) : 96.10 %

NPV (%) : 84.09 %

Diagnostic Accuracy : 63.63 %

## DISCUSSION

In the present study, sensitivity, specificity, positive predictive value and negative predictive value of EPT (Sybron Endo), and Endo-Ice, Coltene Whaledent were assessed. The current gold standard for determining the actual state of pulpal health, i.e. histological examination of the dental pulp is not practical so less invasive reference standards, such as direct inspection of the dental pulp, may be used for comparison.<sup>5</sup> Despite the invasive nature of pulp inspection, it is an objective and valid method for diagnosing the state of pulpal health of teeth when correctly interpreted.<sup>8</sup>

In our study, the mean age of patients ranged from 18 to 60 years. Similarly in a study conducted by Christopher et al.<sup>9</sup> the mean age of patients was between 18 to 71 years. Khattak et al.<sup>10</sup> in their study explained that frequency and percentage of male patients in their study were 391(65.71%) and female patients were 204(34.28%) respectively. Similarly, in our study, the frequency and percentage of male and female patients were 56 (46.3) and 65 (53.7), respectively.

Dastmalchi et al.<sup>11</sup> showed that the sensitivity of cold pulp test was 53% and the specificity of heat pulp test was 55%, whereas Villa-Chavez et al.<sup>12</sup> showed that the sensitivity of cold pulp test was 88% and the specificity of heat pulp test was 100%. Furthermore, there is a lack of consensus regarding the results of different pulp testing methods and which pulp testing method provides the best diagnostic accuracy.<sup>13</sup> This may explain why clinicians often confront clinical situations in which the result of a pulp test on a tooth contradicts those of the other

tests. Many studies on pulp vitality (sensitivity) testing have dealt with a precession of the test; however, the extent to which a test correctly classifies conditions “accuracy” has been incompletely studied. An investigation by Saeed et al. was designed to study the accuracy of three commonly used vitality testing agents through calculating their sensitivity, specificity, and predictive values.<sup>14</sup> Sensitivity and specificity are most commonly used to compare different diagnostic methods because they represent the inherent testing ability.<sup>15</sup> However, in the clinical settings, predictive values can be more useful to clinicians because they represent the probability of a test to provide the correct diagnosis.

The positive predictive value indicates the probability of a tested tooth to indeed have pulp necrosis when a test result is positive, whereas negative predictive value describes the probability of a tested tooth to indeed have vital pulp when a test result is negative. The predictive values, although they are not as often used to compare different pulp testing methods as sensitivity and specificity, serve as a basis for assessing the diagnostic test results in the clinical setting.<sup>16</sup>

Saeed et al. in their study<sup>14</sup>, found that the diagnostic accuracy of thermal testing or Endo ice testing was 84%, where sensitivity, specificity, positive predictive value and negatively predictive of electric pulp test was 69%, 96%, 96%, 70% respectively. However, in our study, the diagnostic accuracy of thermal or Endo ice testing was 63.63%, where sensitivity, specificity, positive predictive value and negatively predictive of electric pulp test was 91.35%, 92.5%, 96.10%, 84.09% respectively. In a study done by Manikar et al., among pulp sensibility

tests, Cold pulp test showed high diagnostic accuracy which is in accordance with our results and

can be considered a primary pulp testing method.<sup>16</sup>

## CONCLUSION

The study reveals that the effectiveness of Endo-Ice (thermal testing) was more positive diagnosis before embarking on root canal treatment as compared to electric pulp test, which in return was friendly for both the operator and patient and was more economical. It is therefore concluded that along with taking a good history and clinical evaluation, use of Endo ice for reaching a definite diagnosis is more reliable.

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