



Original Article

Evaluation of the Two Commonly Used Pulp Tests for Assessing Pulp Vitality and Sensitivity

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ABSTRACT

Electric Pulp Test (EPT) has some limitations in determining the vitality of the pulp. **Objective:** The objective in the current study was to see how well the electric pulp test and the cold test agreed in evaluating pulp vitality and sensitivity. **Methods:** Total one hundred and eighteen patients of both genders who had pulpitis because of dental caries were included in this study. A range of ages were represented from 18 to 50 years old. As part of the informed written consent process, each patient was asked to provide demographic information such as their age, gender and the type of teeth they had. Patients were equally categorized into two groups, Group I received electric pulp test and group II received cold test. Outcomes among both groups were calculated in terms of absence or presence of tingling sensation. Visual analog scale was used to determine pain score among enrolled cases. We used SPSS 23.0 version to analyze the data. **Results:** Among 118 patients, 67 (56.8%) were males and majority of the cases 60 (50.8%) were aged between 26-35 years, followed by age group 18-25 in 35 (29.7%) cases and 23 (19.5%) cases were between age group 36-45 years. Mandibular incisors were the most common tooth found in 47 (39.8%) cases followed by maxillary incisors 32 (27.1%) cases. By using visual analogue scale (VAS), we found that most of the patients had severe pain 90 (76.3%). The rate of vital teeth in group I was 45 (76.3%) and in group II vital teeth found in 41 (69.5%) while remaining tooth were necrotic among both groups 14 (23.7%) and 18 (30.5%). By Kappa's statistics we found that overall frequency of vital teeth among all cases was 86 (72.9%). **Conclusion:** In assessing pulp viability and sensitivity, EPT and cold testing showed great concordance, according to this study.

INTRODUCTION

Tests for the dental professional's diagnostic and treatment planning purposes are called dental pulp tests [1]. A diagnosis of the underlying ailment is often made very quickly when pulp testing is combined with information acquired from the patient's medical history, examination, and other tests, such as radiography. As recently as the late 1970s, pulp testing was used in a wide range of clinical dental settings with varying degrees of effectiveness [1]. This might be seen as the ideal diagnostic test has not yet

been achieved. In terms of accuracy, reliability and reproducibility in a given diagnostic challenge, all present pulp tests have flaws in the technical realm. It is also important to know when to do a pulp test, as not all pulp testing agents are suited for all clinical situations [2, 3]. Thermal and electric pulp sensitivity tests have been performed to examine the pulpal health of teeth by assessing the state of the pulp's nerves [4]. These examinations frequently yield false-positive and false-

negative results when the teeth being examined are young or have been traumatized [5]. Microcirculatory components of the pulp in these cases may still be normal [6]. In dental practice, methods for evaluating the vitality of the pulp have been developed. Using Laser Doppler Flowmetry (LDF) and Pulse Oximetry (PO), researchers claim to be able to see how much blood is flowing through the pulp of the tooth. In clinical scenarios where the dental pulp is sick but still has a functional blood supply, vitality tests may fail to accurately represent the real status of the dental pulp's health while being a stronger indicator of its pulpal health than pulp sensitivity tests. It's uncertain that using vitality tests in everyday practice is worthwhile because they have a number of limitations and their use requires a lot of time and effort [7, 8]. Electric pulp tester sensitizes sensory neurons by electric stimulation. It is a subjective test since it involves patient's response to testing. There are risks of false-negative and false-positive findings in a subjective test. However, EPT is a non-invasive, clinically safe and easy to use approach for evaluation of pulpal health making it aid of choice for many physicians. [9] Endo Ice's sensitivity was found to be 76%, whereas that of the electric pulp test was found to be 92%. Endo Ice had a specificity rate of 92%, whereas EPT had a specificity rate of 75%. [10] Tests for pulp vitality were carried out using heated gutta-percha as well as ethyl chloride and electricity. Examining tooth pulp directly as a reference standard, we were able to compute the test's sensitivity, specificity, negative and positive predictive values. [11] True positives for ethyl chloride and EPT were found to be 88 and 87 percent, respectively, in the research. 89 and 84 percent, respectively, were reported as the actual negatives in these tests. [12, 13] To differentiate between reversible and symptomatic pulpitis (RP and SIRP), the American Association of Endodontists (AAE) recommends the existence of spontaneous or prolonged discomfort following cold and/or hot stimulus removal [14]. There are various essential indications and symptoms that can be utilized to identify symptomatic irreversible pulpitis (SIRP), however the diagnostic criteria supplied by the AAE do not address all of them [15]. Therefore, the objective of our study was to determine the agreement of accuracy of electric pulp testing and thermal testing in determining pulp vitality.

METHODS

This observational/retrospective study was conducted at the Department of Dental Materials, Sardar Begum Dental College, Gandhara University, Peshawar from 1st March, 2021 to 31st December, 2021. In the current study 118 participants of both sexes were enrolled. Informed written consent was taken from all the patients for detailed

demographics included age, sex and type of teeth. Those with full coverage crowns, big restorations, calcified canals or a regressed pulp chamber, recent traumatic damage, root resorption, and an immature apex were excluded from the study. Those who needed root canal therapy for moderate or severe pulpal disease-related pain (VAS 4-7) and VAS 8-10) were included in this research. Patients in the study ranged in age from 18 to 50 years. Patients were equally categorized into two groups, Group I received electric pulp test and group II received cold test. Initial treatment consisted of Coltene Whaledent, Endo-Frost (isobutane 10%-20%, butane 30%-50%, propane 30%-50%), and Endo Frost Pellet applied to the tooth's crown until the patient inquired about a cold or tingling feeling. After 15 seconds, if the patient didn't feel any feeling, the pellet was removed. There was a two-minute break before the following test. Cotton rollers were used to isolate the tooth so that a drop of conductive paste could be applied. The tooth to be evaluated was probed using an electric pulp tester (Integrated Circuit). From unit zero to unit ten, the patient was gradually exposed to an increasing amount of electric current. Any tingling or freezing feeling on the teeth was considered vital, whereas teeth that did not respond were considered non-vital. The intensity and clinical applicability of each test were determined by calculating the agreement between the two assessments and comparing the findings' probable variances. Data were entered and analyzed using SPSS-23.0. For quantitative variables, descriptive statistics were used; for qualitative variables, frequencies and percentages were computed in order to arrive at the mean and standard deviation. Kappa statistics were used to determine if electric pulp and cold test were in agreement, using p 0.05 as a threshold for significance.

RESULTS

Out of total 118 patients, 67 (56.8%) of the cases were males and remaining 51 (43.2%) were females. Majority of the cases 60 (50.8%) were aged between 26-35 years, followed by age group 18-25 in 35 (29.7%) cases and 23 (19.5%) cases were between age group 36-45 years (Figure 1).

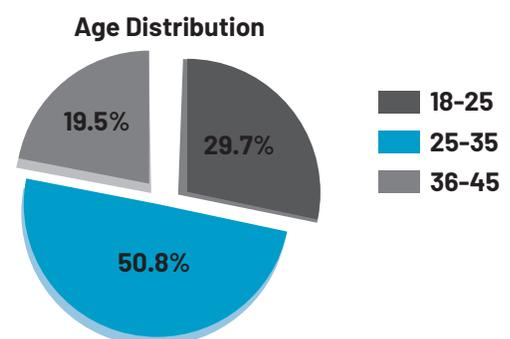


Figure 1: Age (Years) distribution among enrolled cases

Mandibular incisors were the most common tooth found in 47 (39.8%) cases followed by maxillary incisors 32 (27.1%) cases, canine found in 23 (19.5%), molars 10 (8.5%) and premolar was found in 6 (5.1%). By using VAS, we found that most of the patients had severe pain 90 (76.3%) (Table 1).

Variables	Group I	Group II	Total
Types			
Mandibular incisors	23	24	47 (39.8%)
Maxillary incisors	16	16	32 (27.1%)
Canine	12	11	23 (19.5%)
Molars	4	6	10 (8.5%)
Premolar	4	2	6 (5.1%)
VAS pain Score			
Severe	45	45	90 (76.3%)
Non-severe	14	14	28 (23.7%)
Total	59	59	118 (100)

Table 1. Type of teeth among both groups

Frequency of vital teeth in group I was 45 (76.3%) and in group II vital teeth found in 41 (69.5%) while remaining tooth were necrotic among both groups 14 (23.7%) and 18 (30.5%) (Table 2).

Variables	Electric pulp test	Cold Test
Vital Teeth		
Yes	45 (76.3%)	41 (69.5%)
No	18 (30.5%)	18 (30.5%)

Table 2: Association of vital teeth among both groups

By Kappa's statistics we found that overall frequency of vital teeth among all cases was 86 (72.9%) (0.007) with p values 0.000. (Table 3)

Kappa's Stats	Frequency	Percentage
Vital Teeth		
Yes	86	72.9
No	32	27.1

Table 3: Kappa's stat to find out vital teeth frequency

DISCUSSION

In the current study, the validity of two widely used techniques of vitality testing, the cold test and the Electric pulp test was examined. Pulp vitality was determined to be 72.9 percent accurate in 72.9 percent of instances, based on the results of the study. Both assays can be done on their own to evaluate pulp vitality, but the combination of the two will yield more accurate findings. Our findings were comparable to the previous study [16]. Most of the cases 56.8% among 118 patients were males. Majority of the cases 50.8% were aged between 26-35 years, followed by age

group 18-25 of 29.7% cases and 19.5% cases were between age group 36-45 years. The age range of the test respondents is an important consideration when assessing a person's vitality. In the age range of 21 to 50, Jaspersen found that the cold test was accurate [17]. A research comparing the threshold across the age groups of 20-30 and 50-101 found that there was a significant variation in the threshold [18]. Caill's examination comprised the age range of 26 to 38 years old [19]. As a result of the calcification, reduced vascularity, and increased fibrous tissue in the pulp of aged individuals, the results of sensitivity testing were shown to be inaccurate. [20] In our study mandibular incisors was the most common tooth in 39.8%. This was in agreement with previous study conducted in 2020 Zehra T et al in which majority were mandibulars 30.2%, maxillary teeth were 24.5% and frequency of molar were 14.2% [16]. We also found similar results in our study related to types of teeth. In our study vital teeth was found among 76.3% by electric pulp test and 69.5% by cold test. According to previous studies, EPT and cold testing may properly evaluate pulp vitality in more than 80% of the cases [21]. EPT, CO2 test and LDF were shown to be the most trustworthy and accurate tests, according to another study that examined the clinical accuracy, reliability and repeatability of laser Doppler flowmetry (LDF), EPT and other thermal pulp sensitivity test methods. In spite of the fact that EPT is less time-consuming, it has been proven to be less reproducible [22, 23]. While compared to previous studies and investigations, Fuss found no false positive results when testing teeth that had had their pulp extracted during root canal therapy. [24] If the tooth's A fibers are intact, EPT produces electric impulses that activate A fibers, resulting in a reaction. Non-myelinated C-fibers cannot be stimulated by EPT because of the high current required to do so. Depolarization of integral nerves by EPT's electric impulse results in action potentials, which in turn induce the patient's discomfort and pain response [25]. In the current study, after the completion of the cold test, a 2-minute rest period was allowed before moving to the next test was administered. This time period is intended to serve as a nerve healing period before the following test is performed [26]. When evaluating the viability of the same tooth in another trial, the researchers employed a 5-minute interval [9]. Endo frost was employed in the current investigation for the cold testing procedure. Compared to ice or Ethyl chloride, carbon dioxide snow was shown to induce a statistically significant increase in intra pulpal temperature drop. Additionally, it is said that skin refrigerant as well as ice are less consistent than the cold test. During the current trial, if the patient did not respond or reported any feeling, pallets sprayed with endo frost were put on the teeth for 15

seconds. Previous research has followed the procedure outlined below [16, 22, 24]. We discovered that the total frequency of vital teeth among all instances was 86 (72.9 percent), with a p value of 0.000, according to Kappa's statistics. In another investigation, it was discovered that pulp sensitivity testing with Endo Ice and EPT are accurate and reliable ways of measuring pulpal vitality in the pulp [18]. Another study conducted in-house found that the accuracy, sensitivity, and specificity of the cold and electric pulp tests were comparable for the electric pulp test and the cold test [17]. EPT and cold testing were shown to have great agreement in assessing pulp vitality, according to this study. Most of the requirements for an optimum testing procedure are met by electric pulp testers and cold testing. When EPT and Endo frost are used together, the assessment of pulp vitality will be more precise.

CONCLUSION

In assessing pulp viability and sensitivity, EPT and cold testing showed great concordance, according to this study. Electric pulp testers and cold testing currently satisfy the majority of the criteria for an ideal testing procedure and are still widely utilized diagnostic tools. When EPT and Endo frost are used together, a more precise assessment of pulp vitality can be made.

REFERENCES

- [1] Rowe AH, Pitt Ford TR. The assessment of pulpal vitality. *International Endodontic Journal*. 1990;23(2):77-83. doi: 10.1111/j.1365-2591.1990.tb00843.x
- [2] Ehrmann EH. Pulp testers and pulp testing with particular reference to the use of dry ice. *Australian Dental Journal*. 1977;22(4):272-279. doi: 10.1111/j.1834-7819.1977.tb04511.x
- [3] Chambers IG. The role and methods of pulp testing in oral diagnosis: a review. *International Endodontic Journal*. 1982;15(1):1-15. doi: 10.1111/j.1365-2591.1982.tb01331.x
- [4] Gopikrishna V, Pradeep G, Venkateshbabu N. Assessment of pulp vitality: a review. *International Journal of Paediatric Dentistry*. 2009, 19, 3- 15. doi: 10.1111/j.1365-263X.2008.00955.x
- [5] Zadik D, Chosack A, Eidelman E. The prognosis of traumatized permanent anterior teeth with fracture of the enamel and dentin. *Oral Surgery, Oral Medicine and Oral Pathology*. 1979, 47, 173-5. doi: 10.1016/0030-4220(79)90175-0
- [6] Bhaskar SN, Rappaport HM. Dental vitality tests and pulp status. *Journal of the American Dental Association*. 1973, 86, 409-1. doi: 10.14219/jada.archive.1973.0081
- [7] Jafarzadeh H. Laser Doppler flowmetry in endodontics: a review. *International Endodontic Journal*. 2009;42(6):476-90. doi: 10.1111/j.1365-2591.2009.01548.x
- [8] Udoye CI, Jafarzadeh H, Okechi UC, Aguwa EN. Appropriate electrode placement site for electric pulp testing of anterior teeth in Nigerian adults: a clinical study. *Journal of Oral Science*. 2010;52(2):287-92. doi: 10.2334/josnusd.52.287
- [9] Alghaithy RA, Qualtrough AJE. Pulp sensibility and vitality tests for diagnosing pulpal health in permanent teeth: a critical review. *International Endodontic Journal*. 2017;50(2):135-42. doi: 10.1111/iej.12611
- [10] Weisleder R, Yamauchi S, Caplan DJ, Trope M, Teixeira FB. The validity of pulp testing: a clinical study. *The Journal of the American Dental Association*. 2009;140(8):1013-7. doi: 10.14219/jada.archive.2009.0312
- [11] Wilson BL, Broberg C, Baumgartner JC, Harris C, Kron J. Safety of electronic apex locators and pulp testers in patients with implanted cardiac pacemakers or cardioverter/defibrillators. *Journal of Endodontics*. 2006;32(9):847-852. doi: 10.1016/j.joen.2006.03.005
- [12] Strobl H, Gojer G, Norer B, Emshoff R. Assessing revascularization of avulsed permanent maxillary incisors by laser Doppler flowmetry. *Journal of the American Dental Association*. 2003; 134(12): 1597-1603. doi: 10.14219/jada.archive.2003.0105
- [13] Petersson K, Soderstrom C, Kiani-Anaraki M, Levy G. Evaluation of the ability of thermal and electrical tests to register pulp vitality. *Endodontics & Dental Traumatology*. 1999;15(3):127-31. doi: 10.1111/j.1600-9657.1999.tb00769.x
- [14] Gerald N, Glickman L, Jordan L, et al. *Endodontic diagnosis*. Chicago: American Association of Endodontists. 2013.
- [15] Gerald NGL, Jordan L, et al. AAE consensus conference recommended diagnostic terminology. *Journal of Endodontics*. 2009.
- [16] Tazeen Zehra, Fazal-Ur-Rehman Qazi, Yawar Ali Abidi, Shehbaz Ahmed Jat, Saima Khalili, Juzer Saifee. Agreement between Two Commonly Used Pulp Tests in Determining Pulp Vitality. *Pakistan Journal of Medicine and Dentistry*. 2020, 9(02).
- [17] Farid H, Khan FR, Pasha L, Shinwari MS. Are pulp sensibility tests still sensible? *Journal of Ayub Medical College Abbottabad*. 2015;27(4):874-7.
- [18] Jespersen JJ, Hellstein J, Williamson A, Johnson WT, Qian F. Evaluation of dental pulp sensibility tests

- in a clinical setting. *Journal of Endodontics*. 2014;40(3):351-4. doi: 10.1016/j.joen.2013.11.009
- [19] Barczak K, Palczewska-Komsa M, Wilk A, Nowicka A, Buczkowska-Radlinska J, Wiszniewska B, et al. Pulp sensibility to electric stimuli in the Caucasian population. *Australian Endodontic Journal*. 2019;46(1):26-32. doi: 10.1111/aej.12341
- [20] Calil E, Caldeira CL, Gavini G, Lemos EM. Determination of pulp vitality in vivo with pulse oximetry. *International Endodontic Journal*. 2018;41(9):741-6. doi: 10.1111/j.1365-2591.2008.01421.x
- [21] Farac RV, Morgental RD, de Pontes Lima RK, Tiberio D, dos Santos MT. Pulp sensibility test in elderly patients. *Gerodontology*. 2017;29(2):135-9. doi: 10.1111/j.1741-2358.2012.00623.x
- [22] Lin J, Chandler NP. Electric pulp testing: a review. *International Endodontic Journal*. 2008;41(5):365-74. doi: 10.1111/j.1365-2591.2008.01375.x
- [23] Jafarzadeh H, Abbott PV. Review of pulp sensibility tests. Part II: electric pulp tests and test cavities. *International Endodontic Journal*. 2010;43(11):945-58. doi: 10.1111/j.1365-2591.2010.01760.x
- [24] Fuss Z, Trowbridge H, Bender IB, Rickoff B, Sorin S. Assessment of reliability of electrical and thermal pulp testing agents. *Journal of Endodontics*. 1986;12(7):301-305. doi: 10.1016/S0099-2399(86)80112-1
- [25] Pantera EAJ, Anderson RW, Pantera CT. Reliability of electric pulp testing after pulpal testing with dichlorodifluoromethane. *Journal of Endodontics*. 1993;19(6):312-4. doi: 10.1016/s0099-2399(06)80463-2.
- [26] Kalhoro FA, Rajput F, Sangi L. Selecting the appropriate electrode placement-site for electrical pulp testing of molar teeth. *Journal of the Pakistan Dental Association*. 2016;20(03).