

# Traditional Pulp Vitality Testing Methods - An Overview Of Their Limitations

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## ABSTRACT

Pulp vitality testing (PVT) is only one facet of oral diagnosis. An understanding of both the usefulness and limitations of pulp testing methods is essential if they are to be employed in clinical dentistry. Traditional methods which have been followed over the years have still been a point of controversy due to their limitations. With the advent of newer methods assessing pulpal vascularity, it is hoped that it would serve as an efficient diagnostic aid. This paper discusses the limitations of traditional pulp vitality testing methods in detail.

**Keywords:** Diagnosis, limitations, vitality, nerve supply, vascularity, traditional

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## INTRODUCTION

**“No examination of the mouth is complete without vitality tests being carried out on each tooth” – Ebrmann<sup>(1)</sup>**

A diagnosis is not a goal in itself but it has been described as a mental resting place on the way to a treatment decision. Correct diagnosis is the basis for rational therapy and is thus the first step in adequate treatment. Although no single investigation establishes a diagnosis, the omission of a relevant investigation may make correct diagnosis impossible (2).

Pulp vitality testing (PVT) is only one facet of oral diagnosis, which is crucial in monitoring the state of health of the dental pulp (3). Pulp testing has been an ‘overvalued’ and ‘underused’ diagnostic aid. Many researchers and clinicians have overvalued it as they have not realized its limitations and have attempted to use pulp testers in making diagnosis which are beyond their ability. It has been underused, as many clinicians have not realized the valuable information which pulp testers can supply and the essential nature of this information to complete oral diagnosis(2,4).

● **The ideal pulp tester:** Chambers suggested that the technique for evaluation of dental pulp status must

be simple, objective, standardized, reproducible, non-painful, non-injurious, accurate, and inexpensive way of assessing the exact condition of the pulp tissues at any given time. Unfortunately the traditional methods fall short of nearly all the above criteria (2).

## GENERAL LIMITATIONS OF THE TRADITIONAL PULP TESTING METHODS(2)

- **Tissue vitality versus nerve vitality:** They are not true indicators of vitality of the pulpal tissues. Pulp vitality testing is based on the state of blood circulation of the pulp tissues, whereas traditional methods can only establish whether a viable nerve supply exists(1,5,6,7).
- **Lack of correlation with the histological condition of the pulp:** Despite the lack of correlation between test threshold and the specific histological state of the pulp it has been found that there is a statistically significant relationship between absence of a response to the pulp test and the presence of a totally necrotic pulp. There is also a poor correlation between symptoms and pulpal histopathology. According to Marshall these pulp testers do not quantify disease or measure health, so they should not be used to judge the degree of pulp

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disease. However when used within their limitations they can supply information which no other test can supply (4,8,9,10).

- **Lack of objectivity:** The response of a patient to the pulp testing procedure may be considered objective, but in view of the very subjective nature of pain, this suggestion seems unreasonably optimistic. The use of a control tooth on the opposite side of the mouth has been employed as an attempt to remove the factor of subjectivity of an individual's response. Since response intensity does not represent pathological state, comparative testing contributes to no further information. This has several criticisms, as there is no way of knowing whether the control tooth itself is normal without extracting it and observing it histologically (11,12).
- **Lack of reproducibility:** The difference in the response of patient's to pulp tests on different days and at different hours of the same day is controversial due to several reasons as patients seem unable to pinpoint precisely the moment they feel a sensation (13). It is noted that the result of the electric pulp test depends on the state of mind of the patient, and thus is a changeable factor (14).
- **Unpleasant sensation:** All pulp testing methods require the patient to indicate when he or she feels a sensation. Pain is the only sensation elicited by stimulation of pulpal nerves, but patients use many words other than pain to describe the sensation. In most cases the sensation is unpleasant, especially when full-mouth vitality testing is performed (1,13).
- **Effect of maturation status of the tooth:** Erupting teeth show an increased threshold value to electrometric testing, even though their vitality is undoubted. The nerve terminals around the odontoblasts and predentine are not present initially and gradually develop to be fully formed by the time the tooth has been in function for 4-5 years. This explains the results of pulp testing in maturing

teeth, but does not explain the good response of  $CO_2$  tests. Thus while evaluating traumatized anterior teeth in young patients, dentists should take into account the degree of root development (6,14,15,16).

- **Effect of trauma:** As the pulp is in a state of 'shock' following trauma, pulp tests may not give reliable results immediately following traumatic injury. This shock might get resolved in 3 months and that the pattern of vitality is then established. It has been observed that there is superior ability of blood vessels to withstand trauma compared with the nerves. Thus it is recommended that in traumatized teeth endodontic therapy should be delayed, considering the affected pulp tissue to be vital (6,7,17).
- **Multi-rooted teeth:** There exists a problem in assessing the vitality of multirooted teeth when the pulp is vital in one root canal but not in another. This problem cannot be managed by attempting preferential electrical stimulation of the different canals, as the current passes through all the canals. In general, posterior teeth tend to have a higher threshold to electrical stimulation than anterior teeth, apparently because of its bulk (9, 14).
- **Effect of drugs:** Sedative, tranquillizing or analgesic medications taken by the patient will increase the threshold of stimulation of pulpal nerves, but similar effect has also been noted with placebo medication (18,19,20).
- **Age influence:** Except for newly erupted teeth, age of the patient from 10 to 73 years appears to have no effect on pain perception threshold of the pulpal nerves. However increase in threshold to electrical stimulation associated with increased secondary dentine deposition is a normal feature of aging in teeth. It also affects response to thermal test. The elderly people are poorer in discriminating between shocks, due to central nervous system deficit (21).
- **Effect of periodontal disease:** Studies have found that there is no

increase in pulpal stimulus threshold with periodontal disease or with bone loss. According to Bender and Seltzer 'there was strong inferential evidence that teeth with periodontal disease produce high incidences of degeneration and inflammation of the pulp'. They defined a new syndrome pulpodontic- periodontic syndrome which can be of pulpal and periodontal origin with an aggregation of pulpal and periodontal symptoms (21, 22).

- **Sex influence:** No definite differences in pain perception threshold due to sex of the patient have been found (13).
- **Lateral dominance:** It has been suggested that the dominant side has a higher pain perception threshold, but Newton and Mumford found no significant differences between the right and left sides (23).
- **Injury due to pulp testing:** There exists a possibility of pulp-test-induced injuries with some of these tests. E.g. Tests carried out with electric pulp tester involve a gradually increasing current applied to the tooth and rely on conduction along nerve pathways (2).
- **Results of pulp vitality testing:** False positive results are common i.e. when melting ice drips into adjacent teeth/gingival tissues or when electric current applied to tooth surface is conducted to PDL (periodontal ligament) thus stimulating PDL nerve fibers. False negative responses may also occur in cases of calcific metamorphosis, in teeth with immature root formation or subsequent to an impact injury.
- **Subjective response:** These are all subjective tests that depend on the patient's perceived response to stimulus. Inaccurate results may be observed as patient may adapt to avoid a painful stimulus (24).

These vitality tests are in reality sensitivity tests and have no relationship to the vitality of pulp tissue.

#### LIMITATIONS IN CHILDREN

According to Mumford, pulp testing in children below the age of 10 years is unreliable because children may not

cooperate for the test. The incomplete innervations of newly erupted teeth may affect the results (as neural sensitivity in primary teeth varies with the stage of root development and resorption). They may elicit false positive or false negative results if the dentist asks the child leading questions and also the unpleasant stimuli produced by the tester may affect behavior management/cooperative problems with pediatric patients. Though the use of traditional tests helps establish an empirical diagnosis, none of these tests are completely reliable. Thus the validity of children's response in pulp vitality testing has been questioned (25).

Recent studies have shown that blood circulation and not innervation as the most accurate determinant in assessing pulp vitality, as it provides an objective differentiation between necrotic and vital pulp tissue. The unpredictability of testing tooth pulp nerve response is well recognized. When nerve sensations are inhibited or abolished in the tooth traditional tests are of little value, but method based upon the pulpal vasculature response is a better option. Finally one should consider recent methods of pulp vitality testing that attempt to measure the pulpal condition objectively. Recent advances in pulp vitality testing have emerged which record pulpal blood flow, as blood vessels to the pulp supply and mediate the process of acute and chronic inflammation. These newer pulp testing devices which are still underdevelopment are considered to be more accurate and non-invasive. They detect blood supply of the dental pulp through light absorption and reflection - photoplethysmography, pulse oximetry and dual wavelength spectrophotometry or the shift in light frequency as it is reflected back from a tooth, as in laser Doppler flowmetry (2).

With further research these newer

technologies will prove to be effective in assessing pulp vitality.

### CONCLUSION

Pulp vitality is purely a function of vascular health. Traditional pulp vitality testing methods have the potential to produce an unpleasant sensation and inaccurate results. In addition, each is a subjective test that depends on patient's perceived response to a stimulus as well as dentist interpretation of that response. Thus their reliability is questionable. Currently, the significance and reliability of newer methods are being studied. It is hoped that this newer technology would prove to be more valuable, with further research.

### REFERENCES

1. Ehrmann EH. Pulp testers and pulp testing with particular reference to the use of dry ice. *Aust Dent J* 1977;**22**: 272-279.
2. Chambers IG. The role and methods of pulp testing in oral diagnosis: a review. *IEJ* 1982;**15**:1-5.
3. Kayalvizhi G. Reliability of pulp- vitality testing in children: a review. *ENDO (Lond Engl)* 2008;**2**(4):205-209.
4. Marshall FJ. Planning endodontic treatment. *DCNA* 1979;**23**:495-518.
5. Reiss HL, Furedi A. Significance of the pulp test as revealed in microscopic study of the pulps of 130 teeth. *Dental Cosmos* 1933;**75**:272-283.
6. Kaletsky T, Furedi A. Reliability of various types of pulp testers as a diagnostic aid. *JADA* 1935;**22**:1559-1573.
7. Bhaskar SN, Rappaport HM. Dental vitality tests and pulp status. *JADA* 1973;**86**:409-411.
8. Seltzer S, Bender IB, Ziontz M. The dynamics of pulp inflammation: correlations between diagnostic and actual histological findings in the pulp. *Oral Surg Oral Med Oral Pathol* 1963;**16**: 846-71,969-977.
9. Lundy T, Stanley HR. Correlation of pulpal histopathology and clinical symptoms in human teeth subjected to experimental irritation. *Oral Surg Oral Med Oral Pathol* 1969;**27**:187-201.
10. Seltzer S, Bender IB. Differential diagnosis. In *The dental pulp: Biologic considerations in dental procedures.*

Chapter 18, 3<sup>rd</sup> edition JP Lippincott co., Philadelphia, 2000:367-368.

11. Kulild JCB. Diagnostic testing. In Ingle JI, Bakland LK, Baumgartner JC. *Endodontics* 6. Chapter 14, Lea and febiger, Philadelphia 2008: 532- 546.
12. Chilton NW, Fertig JW. Pulpal responses of bilateral intact teeth. *Oral Surg Oral Med Oral Pathol* 1972;**33**:797-800.
13. Mumford JM. Pain perception threshold and adaptation of human normal teeth. *Archives of Oral Biology* 1965;**10**:957-968.
14. Grossman LI. Clinical diagnostic methods. In *Endodontic practice.* Chapter 1, 10<sup>th</sup> edition Lea and febiger, Philadelphia 1987;17-26.
15. Klein H. Pulp responses to an electric pulp stimulator in the developing permanent anterior dentition. *J Dent Child* 1978;**45**: 199-202.
16. Bernick S. Differences in nerve distribution between erupted and non-erupted human teeth. *J Dent Res* 1969;**43**:406-411.
17. Barkin PR. Time as a factor in predicting the vitality of traumatized teeth. *J Dent Child* 1973;**40**:188-192.
18. Bolden TE, Lemah D, Siebert W, Stewart EB. Effect of prolonged use of analgesics on pulpal response- a preliminary investigation. *J Dent Res* 1975;**54**:B198-200.
19. Rost A, Schenck EG. The effect of tramadol and other analgesics on the pain threshold in human dental pulp. *Arzneimittel Forschung* 1978;**28**:181-183.
20. Blair AE. The efficacy of placebo on pain perception threshold. *Oral Surg Oral Med Oral Pathol* 1965;**20**:384-391.
21. Rubach WC, Mitchell DF. Periodontal disease, age, and pulp status. *Oral Surg Oral Med Oral Pathol* 1965;**19**:482-493.
22. Bender IB, Seltzer S. The effect of periodontal disease on the pulp. *Oral Surg Oral Med Oral Pathol* 1972;**33**:458-472.
23. Newton AV, Mumford JV. Lateral dominance, pain perception and pain tolerance. *J Dent Res* 1972;**51**:940-942.
24. Gazelius B, Olgart L, Edwall B, Edwall L. Non-invasive recording of blood flow in human pulp. *Endod Dent Traumatol* 1986;**2**:219-221.
25. Asfour MAM, Millar BJ, Smith PB. An assessment of the reliability of pulp testing deciduous teeth. *Int J Pediatr Dent* 1996;**6**:163-166.