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# The Effect of Dental Flourosis on the Electric Pulp Tester Response and Probe Placement Site.

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**Abstract**

**Introduction:** The probe placement site for an electric pulp tester (EPT) will have a significant outcome for the threshold readings. These relationships in previous studies have been documented. As dental flourosis is an endemic in regions of Pakistan the aim of this study was to compare and determine the appropriate EPT probe placement sites on fluorotic and non flourotic teeth.

**Methodology:** In this cross-sectional clinical study equal number of flourotic and non flourotic maxillary central incisors (40 volunteers) were selected from a known region of Pakistan for endemic of flourosis to measure threshold levels on EPT on four different parts of each tooth. (Incisal edge, incisal third, middle third and cervical third). Before the readings were taken flourotic teeth were also categorized on the bases of severity (Deans Index).The purpose was to assess if severity of dental flourosis had an impact on the EPT readings. Once the mean values were taken the Dunn–Bonferroni post hoc tests was used to assess the statistical significance ($p<0.05$) between the four site in both groups.

**Results:** Mean values from the EPT presented that the threshold values increased from incisal to cervical in gender and both age groups i.e. 20-29 and 30-40. It was also found that the threshold values increased from incisal edge to the cervical third in flourotic and non flourotic teeth. Statical significance was found between the reading of flourotic and non flourotic groups across the four probe site readings taken (p value= 0.00). Like previous literature the insical edge was considered the most ideal site for EPT assessment on anterior incisors. As this is where the lowest threshold response was recorded in our study .Dental flourosis does have a significant effect on the EPT threshold values. This is most likely due to structural changes because of dental flourosis.

**Recommendations:** From the study conducted it can be recommended that clinicians need to be aware of the fact that fluorotic teeth response will vary from natural teeth on the EPT. Also further research needs to be done to assess if other vitality test methods will also alter in their response due to dental defects like flourosis.

**Keywords:** *Dental flourosis, electric pulp tester, maxillary central incisors.*

## 1.0 Introduction

One of the many anomalies in teeth is flourosis. It is an enamel developmental condition that affects ameloblasts during the mineralization stage as a result of systemic fluoride intake exceeding the recommended level of 1 ppm/day[1, 2]. Dental flourosis primarily affects those who reside in places with high fluoride levels in their water supply. It is defined as a developmental condition of the tooth enamel caused by excessive fluoride exposure that most commonly affects children. A high fluoride quantity during tooth development can disrupt cells called ameloblasts, which are important for enamel creation. The alterations in the enamel are caused by interactions between the mineral matrix of the growing enamel and ameloblasts leading to changes in the structure of the enamel[3, 4]. The purpose of vitality tests in dental practice cannot be overemphasized as these are non-invasive and reproducible methods to assess the pulpal status. From assessing pulpal anesthesia success to diagnosis of pathologies pathologies the use of vitialy test like electric pulp tester are a daily investigation for dental practioners. But these techniques' i.e. cold test, electric pulp tester and hot test are somewhat dependent on the anatomy of the tooth structures [5, 6].

Previous literature has shown that the probe site placement for electric pulp tester (EPT) is significant for clinical assessment. While the rationale for this is the variation of the tooth structures i.e. dentin and enamel at different points of the tooth surface and distance of pulp from the EPT probe[7, 8, 9]. Based on these facts it is expected that anomalies such as dental flourosis should also have effects on the reading and probe placement site. As literature has identified that for normal maxillary incisor teeth the optimum site is incisal edge[10, 11,12,13,14.] It is also important to asses in anomalies like dental flourosis also have an effect on the optimum probe placement site for anterior teeth. To our knowledge few researches have been conducted on this concept so the significance of this study is evident. The aim of this study was to investigate the optimum probe placement site for electric pulp tester by determining the lowest threshold responses site on anterior teeth with dental flourosis. Also, if there is any association between the severity of flourosis and threshold response.

## 2.0 Material and Methods

This cross-sectional clinical study was carried out in the Department of Operative Dentistry and Endodontics, Ayub Medical and Dental College, Khyber Pakhtoonkhawa (KP), Pakistan. Ethical clearance for the study was obtained from the Research and Ethics Committee Ayub medical college (Ref.No.RC-2022/EA-01/048).

The participants were given complete information about the procedure and their consents taken. A total of eighty volunteers (40 fluorotic &40 non fluorotic) of either gender, between 20 and 39 years old with intact maxillary central incisors and Deans Index[2] score 0-5 were selected. Before starting the trial, all of the volunteers were given an oral prophylactic treatment i.e. scaling and polishing for better assessment of flourosis. After wiping the teeth dry and assessing the fluorotic severity according to the Deans Index, two different investigators performed clinical examinations independently. Furthermore, to avoid operator bias, scores were recorded independently. Included were teeth with no history of orthodontic treatment or damage also teeth with baseline bitewing and periapical radiographs showing no signs of periapical or radicular pathology. The study eliminated teeth having evidence of surface loss, metallic restorations, deformed teeth, traumatized teeth, endodontically treated teeth, and teeth with periapical disease. The study excluded

participants who used or had history of use of narcotics, alcohol, or non-steroidal anti-inflammatory drugs.

### 2.1 Data collection

The tooth to be tested was isolated. The test was performed according to the manufacturer's instructions using a DIGITEST II™ Electric pulp vitality tester. (Kot Lakpat, Lahore, Pakistan) (a monopolar EPT with anodal electrode probe tip and diameter of 2 mm was used in the study). When the subject rested a finger on the EPT's lip clip, the circuit was complete. A moderate pulsed stimulus was delivered to the tooth with the tip of the electrode gently coated with toothpaste as a conducting medium, and the subject felt and observed a sensation such as tingling, stinging, warmth, or heat. They were told to release the clip as soon as they felt anything warm, tingly, or unpleasant. The threshold was defined as the point on the pulp tester's digital display when the subject first noticed the sensation described above. Each tooth's labial surface was evaluated at four different locations (incisal edge, incisal third, middle third, and cervical third). Starting from the incisal edge to the cervical third, four readings were taken on the labial surface of each site in order. Before returning to the tooth, at least 1 minute had passed to eradicate the phenomena of nerve accommodation. Each site was given a score based on the average of the four readings.

### 2.2Analysis

SPSS was used to examine the data (IBM SPSS Statistics Version 22.0.0.329). The Dunn–Bonferroni post hoc tests were used for comparing threshold responses on different sites. ($p>0.05$)

### 3.0 Results

Eighty subjects consisting of 37 males and 43 females with age range from 20 to 39 participated in this study (Table 1&2). Seventy five percent of the participants were in the age range of 20-29. Deans index score distribution across age and gender in the population is given in Table 3.

**Table 1: Age distribution**

| Age groups | Distribution | Percentage |
|---|---|---|
| Group 1 20-29 | 60 | 75% |
| Group 2 30-39 | 20 | 25% |

**Table 2: Gender distribution**

| Sex | Distribution | Percentage |
|---|---|---|
| Males | 37 | 46.3% |
| Females | 43 | 53.8% |

**Table 3: Deans index score distribution across age and gender**

| | | Non fluorotic | Flourosis | | | | |
|---|---|---|---|---|---|---|---|
| | | | Questionable | Very mild fluorosis | Mild fluorosis | Moderate fluorosis | Severe fluorosis |
| **Gender of patients** | Male | 19 | 6 | 3 | 5 | 2 | 2 |
| | Female | 21 | 3 | 7 | 7 | 4 | 1 |
| | Total | 40 | 9 | 10 | 12 | 6 | 3 |
| **Age group** | 20-29 | 29 | 8 | 8 | 9 | 4 | 2 |
| | 30-39 | 11 | 1 | 2 | 3 | 2 | 1 |
| | Total | 40 | 9 | 10 | 12 | 6 | 3 |

Lower EPT values were recorded for the incisal edge compared to other sites in both normal subjects and subjects with flourosis. Lower threshold values of EPT were found in males and age group 20-29. Lowest threshold reading was recorded at incisal edge and this reading gradually increased to cervical area in all groups (table 4).

**Table 4: Readings of EPT at the four sites in all groups.**

| Variables | | Average values of EPT | | | |
|---|---|---|---|---|---|
| | | IE | IT | MT | CT |
| **Gender of patient** | Males | 19.4 | 23.9 | 28.89 | 33.64 |
| | Females | 20.2 | 24.62 | 29.27 | 33.55 |
| **Age group** | 20-29 | 19.91 | 24.15 | 28.9 | 33.21 |
| | 30-39 | 19.90 | 24.75 | 29.5 | 34.75 |

*Note: IE= incisal edge, IT= incisal third, MT= middle third, CT= cervical*

The Dunn–Bonferroni post hoc tests showed significant differences (p value 0.00) in threshold readings between all four sites when compared statistically. This was not only in non flourotic teeth but flourotic teeth as well. From the table 5 it can be seen that as the severity of flourosis increases on the Deans Index so does the threshold response reading. The increase in threshold values follows the same pattern in flourotic teeth based on site as it does in non flourotic i.e increasing values from insical edge to cervical third.

**Table 5: EPT values on all four sites with respect to Deans Index Scores.**

| Deans Index (score) | Average value of EPT in Fluorotic & Normal teeth | | | | |
|---|---|---|---|---|---|
| | **IE** | **IT** | **MT** | **CT** | **P value*** |
| ***Normal teeth(0)*** | *13.5* | *18.6* | *24.4* | *29.6* | *0.00* |
| **Questionable (1)** | 19.2 | 22.4 | 25.5 | 28.8 | 0.00 |
| **Very Mild (2)** | 23.7 | 27.1 | 30.6 | 34 | 0.00 |
| **Mild (3)** | 27.6 | 31.8 | 35.5 | 39.9 | 0.00 |
| **Moderate (4)** | 33.1 | 37 | 41 | 44.8 | 0.00 |
| **Severe (5)** | 36.6 | 41 | 46.6 | 51.6 | 0.00 |

**statistically significant difference at P< 0.05*

## 4.0 Discussion

In previous literature on electric pulp tester have given recommendations regarding optimum probe placement site for teeth. According to Christopher et al insical edge was the optimum site for electric pulp tester placement as; the response was recorded at the lowest thresholds at the incisal edge of anterior teeth[15]. Bargale and Padmanabh reported that the occlusal surface is the best site for electric pulp tester probe placement for maxillary and mandibular premolars[16]. The mesiobuccal cusp tip is the best location for first molar pulp testing, according to Lin et al[6]. For this study, which differs from prior ones in terms of sample size, selected population, and study design, maxillary central incisors with sound crowns were chosen. Still in the non flourotic group of our study we also found the incisal edge to record the lowest threshold in anterior teeth.

The selection of patients with dental flourosis was done on the fact the previous regional studies[17, 18] had pointed out the province of KPK in Pakistan as a probable endemic zone of dental flourosis because of underground water supplies high content of fluoride. With such a big population being affected by flourosis it is was important to assess if flourosis would have an effect on reading of EPT or site for probe placement. Such investigations would, on the one hand, aid in identifying the best placement locations for fluorotic teeth, which might differ from sound teeth. On the other hand, it clarifies one of the repercussions of the alterations in dentin and enamel of fluorotic teeth, as it influences the evaluation of the pulp. Specifically, in assessing the impact of excessive fluoride on the size, form, and quality of enamel crystal[19, 20,21]. There is still debate on crystal dimensions; the vast majority of research to date has found that fluorotic human teeth have crystals with a noticeably larger diameter. Additionally, it was discovered that these huge crystals had smaller, atypically shaped crystals linked to them on the hypermineralized enamel surface[22, 23].

In this study, threshold reading were taken from four sites on the maxillary central incisors with or without dental flourosis (DF). We found that the response threshold was lowest at the insical edge of the non flourotic teeth. These readings were lower than the flourotic teeth irrespective of the Deans Index scores. Vemisetty et al. reported the same sequence in their study[24]. These results may be explained by an increase in enamel resistance because current must flow across the thickened enamel prisms caused by DF. While literature clearly states that the thickness of enamel will have an effect on the EPT readings[25]. In fluorotic teeth, it has been proposed that the hyper-

mineralized enamel and its fluoro-apatite crystals cause shifts in the dentinal fluid's ionic content or concentration. These could also be to blame for the greater thresholds observed in this study with fluorotic teeth as compared to non fluorotic teeth. It has been demonstrated in literature that the two main intrinsic determinants of the threshold levels of various places on the tooth are the thickness of enamel and the concentration of nerves. In permanent teeth, the pulp horns have the densest concentration of nerve fibers and the thinnest enamel[19,26]. Which is the incisal edge in anterior teeth as nerve ending concentration will decrease significantly toward the cervical regions of the anterior teeth[27]. These claims are supportive of the threshold values found in this investigation, which were highest at the cervical third and lowest at the incisal margins of the incisors for both fluorotic and non-fluorotic teeth. Other studies have revealed similar results for the anterior teeth[15,28]. An in vitro study by Jacobson et al only demonstrated the middle third of the labial surface of maxillary incisor teeth to be the site for lowest threshold readings[29]. But no recent literature would correspond with this finding.

A few drawbacks can be pointed out in this study. Firstly the sample sizes, especially as the bulk of subjects were between 20-29 yrs. Reason being convenience and minimal alteration like secondary or tertiary dentin formation in younger individual's teeth[30, 31,32]. Second, there is not enough local literature or data to review.

## 5.0 Conclusion

Based on the study and keeping in view the drawbacks the following conclusions can be withdrawn.

1. Compared to fluorotic teeth, non-fluorotic teeth respond to lower EPT threshold levels.

2. The incisal edge is the best location to place a probe when using the EPT in maxillary incisor teeth.

3. The presence or absence of DF is the important distinction between the two study groups. Therefore, structural changes in the people with DF's enamel would be the reason for the variations in the threshold values.

## 6.0 Recommendations

From the study conducted it can be recommended that clinicians need to be aware of the fact that fluorotic teeth response will vary from natural teeth on the EPT. Also further research needs to be done to assess if other vitality test methods will also alter in their response due to dental defects like flourosis.

## Conflict of interest

The authors deny any conflict of interest.

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