

## SELECTING THE APPROPRIATE ELECTRODE PLACEMENT-SITE FOR ELECTRICAL PULP TESTING OF MOLAR TEETH



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**OBJECTIVE:** The objective of the present experimental study was to report an appropriate electrode placement site on first molar teeth.

**METHODOLOGY:** Fifty volunteers with sound mandibular and maxillary first molar teeth (without any lesion or restoration) were selected from the Dental OPD of Dept. of Operative Dentistry LUMHS Jamshoro from July 2008 to June 2009. Seven sites on each tooth were tested two times. The Elements Diagnostic Unit EPT was used to record the lowest threshold response of each site. Data was analyzed with one-way analysis of variance and the tukey test.

**RESULTS:** The central fossa/pit of both maxillary and mandibular first molar teeth was found to be an appropriate site for EPT testing. Whereas, the tip of mesiobuccal cusp was the second site where lowest threshold was found to elicit pulpal response. No significant difference was observed between male and female subjects and between mandibular and maxillary molars.

**CONCLUSION:** The experiment showed that the central pit might be an optimum site for placement of EPT probe tip.

**KEYWORDS:** Pulp, molar, diagnosis, endodontics, electrical pulp testing

### INTRODUCTION

**D**iagnosis in dentistry can be defined as the process to obtain data by questioning, examining and testing the subject to identify deviations from the normal.<sup>1</sup> The determination of pulpal status is a crucial step in diagnosis before embarking restorative or endodontic treatment and that can only be done by remaining adherent to the rules of diagnosis like proper history, clinical examination, radiographic evaluation and special tests.

These special tests include thermal test, electrical pulp test (EPT) Laser Doppler flowmetry, pulse oximetry etc.<sup>2</sup> The Electric pulp tester is being widely used as a diagnostic tool of diseases involving pulp and periapical tissues.<sup>3</sup> EPT is a battery-operated instrument, which is connected to two electrodes (Anode and Cathode). One electrode is put in the patient's hand and other placed over the surface of tooth under investigation. An electrical current starts to flow across both the electrodes and tooth

surface which in turn elicits a response in terms of a tingling sensation by stimulating the A $\delta$  nerves in the pulp-dentine complex. That response threshold can be achieved only when sufficient numbers of nerve terminals are activated by electrical current, which is called a summation effect.<sup>4</sup>

A positive response indicates vital pulp where as a negative response indicates necrosed pulp. Thus, EPT only provides information about nerve supply of the pulp not vascular supply which is the true determinant of vitality.<sup>5</sup> Despite this EPT is indeed an integral part of the diagnostic tools of diseases of pulpal origin.<sup>6</sup>

There are several clinical considerations regarding pulp vitality testing with EPT including isolation of the tooth, conducting media, wearing of gloves, type of tooth, thickness of enamel and dentine and site of placement of the tip of probe.<sup>7</sup> Ideally, the tip of probe (electrode) should be placed over an area of high neural density to produce early and powerful response with least electrical current. A few studies have reported an appropriate position for the placement of electrode tip on incisors and premolars.

The incisal edge has been suggested an optimum site in anterior teeth for placing the probe tip to evoke a response with the least amount of electrical current.<sup>8</sup> On the other hand the site for posterior teeth has yet to be

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reported as the EPT in posterior teeth has limited role. The surface area of molars is more and so the thickness of both dentine and enamel to minimize the role of EPT in the teeth. As very few studies have reported electric pulp testing of molar teeth, the dilemma for an optimum site of electrode positioning on molar teeth is yet to be solved.<sup>9</sup> The aim of present study is to report a suitable site for placement of electrode during pulp testing of molars to elicit the maximum response at lowest threshold level.

### METHODOLOGY

Fifty volunteers of either gender were selected of 18-30 year old age group at the department of operative dentistry from July 2008 to June 2009. All participants were fully informed in detail about the study procedure and risk. A written informed consent was signed prior to procedure. Healthy right and left 1st Molars of both mandibular and maxillary arches were selected for study purpose. Carious teeth, restored teeth or teeth with signs of surface loss were excluded from the study. Periapical and bite-wing radiographs were taken of the teeth under study to rule out any proximal caries or apical pathology. Rubber dam was applied to prevent any salivary contamination of the surfaces of teeth. Seven sites on each molar were selected for testing with electrical pulp tester elements diagnostic. (sybronEndo Redmond, WA, USA).

1. Cervical 1/3 of mesio-buccal surface
2. Middle 1/3 of buccal surface
3. Mesio-buccal cusp tip
4. Mesio-lingual/palatal cusp tip
5. Mesio-lingual/palatal surface middle 1/3
6. Mesio-lingual palatal surface cervical 1/3
7. Central fossa

A fluoride gel (Fluocal Septodont) was applied over the tooth surface as conducting media. Each site was tested two times with a 5 minutes interval as nerve recovery Period.

The threshold values were recorded on prescribed Performa. Data was analyzed by SPSS.10 computer software. One-way analysis of variance test and t-test was used at the 0.05 level to determine significance of difference in the thresholds of seven site.

### RESULTS

Out of fifty participants there were 28 males and 22 females. Age ranged from 18-28 years with 23 years as the mean age. The EPT values for all sites ranged from 6-75 and their mean ranged from 15-61. The mean values of the seven sites recorded on right and left 1st molars of both the arches are shown in Table No.1.

| Type of tooth                          | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 |
|--|--------|--------|--------|--------|--------|--------|--------|
| Maxillary right 1 <sup>st</sup> molar  | 32     | 23     | 14     | 29     | 44     | 51     | 13     |
| Maxillary left 1 <sup>st</sup> molar   | 40     | 35     | 28     | 35     | 47     | 53     | 16     |
| Mandibular right 1 <sup>st</sup> molar | 41     | 26     | 23     | 34     | 61     | 61     | 20     |
| Mandibular left 1 <sup>st</sup> molar  | 26     | 29     | 21     | 31     | 44     | 57     | 16     |
| Total                                  | 35     | 28     | 24     | 32     | 49     | 55     | 16     |

Table no.1 : 1st molars Mean EPT values

| Sex    | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 |
|--------|--------|--------|--------|--------|--------|--------|--------|
| Male   | 37     | 29     | 24     | 28     | 44     | 54     | 15     |
| Female | 29     | 28     | 23     | 45     | 63     | 58     | 18     |

First molars Mean EPT value for male and female subjects

| Arch                              | Site 1 | Site 2 | Site 3 | Site 4 | Site 5 | Site 6 | Site 7 |
|-----------------------------------|--------|--------|--------|--------|--------|--------|--------|
| Maxillary 1 <sup>st</sup> molars  | 36     | 29     | 26     | 32     | 54     | 52     | 14     |
| Mandibular 1 <sup>st</sup> molars | 33     | 27     | 22     | 33     | 52     | 59     | 18     |

Mean EPT values of maxillary and mandibular 1st molar teeth

The response at lowest threshold was found at the Central Fossa of all the four molar teeth. The next site which responded where as at low threshold was the mesiobuccal cusp tip. The mean values for each sites progressed from low to high beginning with central fossa, tip of mesiobuccal cusp, middle 3rd of mesiobuccal surface, tip of mesiolingual cusp, cervical 3rd of mesiobuccal cusp, middle 3rd of mesiolingual cusp and cervical 3rd of mesiolingual cusp.

The difference in EPT response values of mandibular and maxillary molars was not found significant P =0.018 (Figure.1)

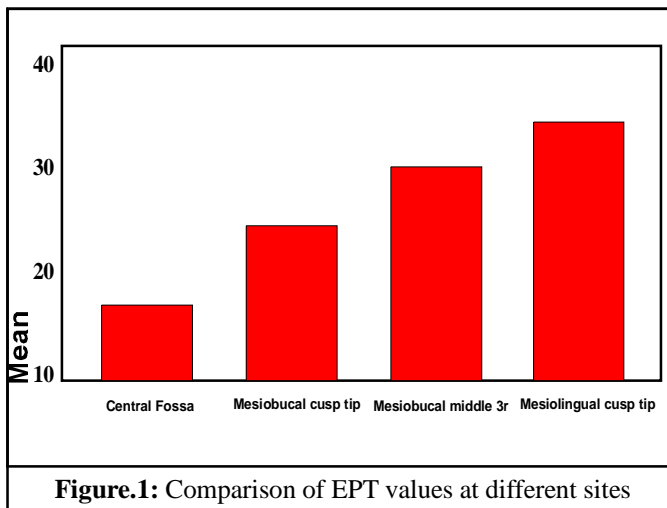


Figure.1: Comparison of EPT values at different sites

The difference in response for both male and female

object was also not significant  $P=0.89$  (Figure.2) and

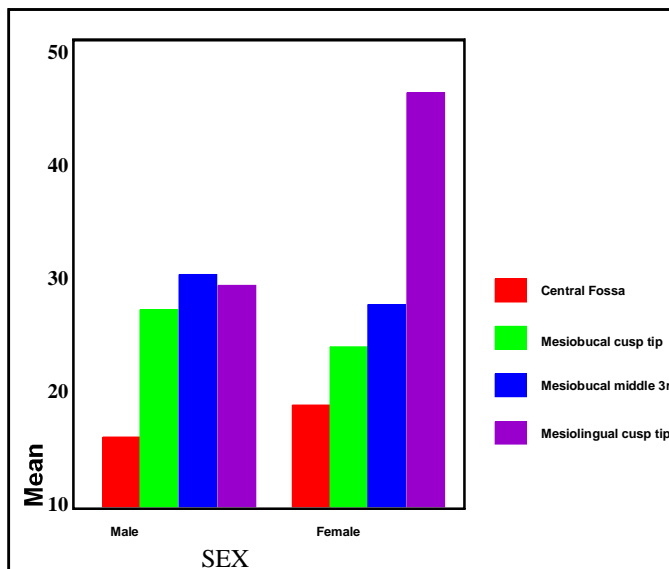


Figure no 2: Comparison of EPT value in male and female subjects

similarly between different sites (Figure. 3).

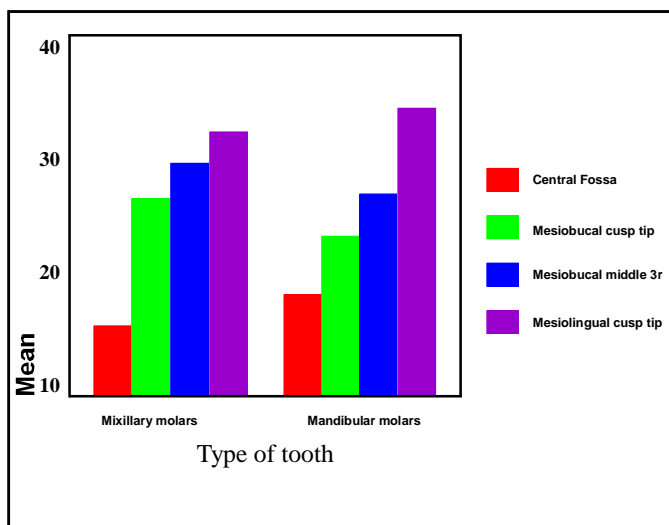


Figure no 3: Comparison of EPT values in maxillary and mandibular first molar teeth

## DISCUSSION

The central fossa of both maxillary and mandibular molars was found as the site with lowest EPT value in our study. Perhaps, this site was never examined in previous studies. To avoid flow of current to the adjacent teeth and gingiva, a rubber dam was used to isolate the tooth being examined. A narrow range of age of subject were selected to avoid sensitivity variation caused by secondary dentine deposition which causes reduction in volume of pulp,

dental caries and tooth wear. Molars are multi-rooted teeth in the dental arch and usually their roots contain more than one pulp canal. There is as well defined pulp chamber in the trunk of the tooth with pulp horns elongated under each cusp but more profound under the mesiobuccal cusp of mandibular molars and mesiopalatal cusp, of maxillary molars. Due to these typical anatomical features it is very difficult to perform pulp vitality procedures especially by Electrical Pulp Testing with more chances of getting false-positive and false-negative responses.<sup>10</sup> It is not uncommon for an infected molar containing necrosed pulp in one canal and some vital pulp in other canal eliciting a false-positive response in an otherwise necrosed pulp. Whereas, the enamel over the crown is also thicker compared to incisor teeth especially over the cusps which can hamper the conduction of electrical current towards the pulp to produce a response.<sup>11</sup> So, it should be more important to place electrode tip at an appropriate site on molars to produce an optimum response. But, the selection of appropriate site is yet to be confirmed and there are still several considerations and lack of research. The response threshold can be achieved only when sufficient numbers of nerve terminals are activated electrical current, which is called a summation effect.<sup>12</sup> The level of response to a given stimulus depends upon how close the nerve terminals are present in the area of stimulus. Therefore, an area where a neural density is found high can give an early and powerful response on least electric current as compared to an area with low neural density.<sup>13</sup> Lilja J. reported that in permanent molar teeth the highest concentration of neural elements are present in the pulp horns, which progressively decrease in the cervical and radicular regions of the pulp.<sup>14</sup> This was confirmed by Lin et al<sup>15</sup> in their study that the early response observed on low electric current at the area of cusp tip as compared to the cervical regions of the molars. On the contrary, the findings of our study are suggesting that the central fossa of 1st molar teeth of both maxillary and mandibular arch is the site where response can be elicited on lowest EPT value whereas, the cusp tip of mesiobuccal cusp is second lowest site for EPT testing. However, the central fossa site has never been examined in previous studies. It has been suggested that the most desirable area of placement of electrode tip is where enamel is thin or absent and in molar teeth central pit/fossa is the area where enamel is seen thin or usually absent.<sup>16</sup> Another laboratory based study by Jacobson used an oscilloscope to find the electrode placement site on extracted incisors and premolars.<sup>19</sup> He observed incisal third and occlusal third of labial/facial surface as an appropriate site for pulp testing in incisors and premolars respectively. However, his study was performed on extracted teeth where neural density was not considered. The Gender of the subject was not found as a factor which impact on level of threshold during pulp testing of the teeth in almost all previous studies.<sup>15,20-21</sup> The present study

also found no statistically significant difference in the responses of male and female subjects nor between maxillary and mandibular teeth as similar to the study of lin et al.<sup>15</sup>

Although different conducting mediums are suggested in literature, we used Fluoride gel to ensure that maximum current passes from the electrode to the tooth surface.<sup>22,23</sup> A laboratory study by Martin<sup>24</sup> and co-workers found no profound difference in using different mediums on either the voltage or the electric current transmitted during the pulp testing of the teeth. On contrary, a more recent study reported difference in the response of same teeth to EPT testing by using different conducting media.<sup>25-27</sup> The present experiment found central fossa/pit as the best electrode site for pulp testing of 1st molar teeth of both mandibular and maxillary arch in contrast with previous study which found the cusp tip of mesiobuccal cusp as the appropriate site.<sup>15</sup> However it should be noted that in the previous study central pit was not included among the seven sites tested by the operators. It is important to select an appropriate site for diagnostic purpose and for future studies on local analgesics in which EPT is often used to assess the effectiveness and longevity of anesthesia.

## CONCLUSION

The present experiment showed that the central fossa/pit of all first molar teeth was an appropriate site for the placement of the tip of EPT. Where as, mesiobuccal cusp tip was found next site with low threshold response. No significant difference were found between male and female subjects and between mandibular and maxillary molars.

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