

Appropriate Electrode Placement Site for Electric Pulp Testing First Molar Teeth

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Abstract

Twenty volunteers with first molars free of restorations and caries were recruited. One molar from each arch was selected, and rubber dam was applied. Seven sites on each crown were electric pulp tested 4 times with an Elements Diagnostic Unit, and lowest threshold responses were recorded. Data were analyzed with one-way analysis of variance and the Tukey test at the .01 level. The lowest response for both the maxillary and mandibular teeth was with the probe on the mesiobuccal cusp tip. Other sites showed an increase in level from the mesiobuccal cuspal surface, mesiobuccal gingival surface, and the center of the supporting cusps (palatal of maxillary molar, buccal of mandibular molar). No significant difference in responses was found between male and female subjects; however, male subjects responded at higher thresholds than female subjects on all test sites except the mesiobuccal cusp tip. The optimum site for pulp testing first molars is the mesiobuccal cusp tip. (*J Endod* 2007;33:1296–1298)

Key Words

Diagnosis, endodontics, molar, pulp testing

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Electric pulp testers (EPTs) are widely used diagnostic tools in endodontics. They deliver a current sufficient to overcome enamel and dentin resistance to stimulate the myelinated sensory fibers (A δ fibers) at the pulpal-dentinal junction. The unmyelinated C fibers of the pulp do not respond because greater current is needed to stimulate them (1). The ability of electric tests to indicate pulp vitality is based on sensitivity of neural transmission, which can lead to false-positive and false-negative values (2), but a positive response usually indicates that there are vital sensory fibers present.

Testing with an EPT requires electrode contact onto tooth surface. Studies have reported the optimum positions of the electrode for anterior teeth and premolars (3–7). Bender et al (7) concluded that placing the electrode at the incisal edge of anterior teeth evoked a response with the least amount of electrical current. Several studies have reported electric pulp testing of molars (3, 8–16). The electrode was placed on the occlusal third of the buccal surface (8), midway between the gingival margin and occlusal edge of the buccal surface (11–13), on the cervical third of the buccal surface (3, 9, 14), or the site was not stated (10, 15, 16). These studies, however, were not designed to determine optimum electrode positioning, and comparative data for different sites are lacking.

The objective of electric testing is to determine the sensibility of each tooth at the lowest sensory response threshold. This experiment aimed to determine the best site on first molars and was based on the study design for anterior teeth (7).

Methods and Materials

Twenty volunteer dental students (12 male and 8 female) aged between 20–25 years were recruited from the School of Dentistry, University of Otago, after ethical committee approval of the project. Participants gave their informed consent after having been provided with written details of the procedure.

All their first molars were free of restorations and caries, and there was no recent history of orthodontic treatment or trauma. Recent bitewing radiographs were available for all participants and confirmed absence of disease. No teeth had unusual occlusal wear. One molar from each arch was randomly selected, and rubber dam was applied without clamps. An EPT (Elements Diagnostic Unit; SybronEndo, Anaheim, CA) was used in accordance with the manufacturer's instructions. The machine reads from 0–80 units, and the rate of increase was set to 2 to allow accurate determination of the first perception of the stimulus.

The electrode tip was lightly coated with fluoride gel (Topical APF Gel; Pascal, Bellevue, WA) and positioned on the testing site. Participants used their thumb and forefinger on the lip clip to complete the circuit. They were instructed to release the clip on first detection of a warm, tingling, or painful sensation.

Seven sites on each first molar crown were tested (Fig. 1). They were the mesiobuccal cusp tip, mesiobuccal cuspal surface, mesiobuccal gingival surface, the center of the supporting cusps (palatal of maxillary molar, buccal of mandibular molar), distobuccal cuspal surface, distobuccal gingival surface, and the center of the guiding cusps. Subjects drew numbered balls from a bag to determine their testing sequence.

Four EPT readings were made at each site. Between the tests, the teeth were air dried, and a recovery period of at least 1 minute was allowed to eliminate the phenomenon of nerve accommodation (6, 17).

Data were analyzed with SPSS software (SPSS 13.0; SPSS Inc, Chicago, IL) by using a one-way analysis of variance test and the Tukey honestly significant difference test at

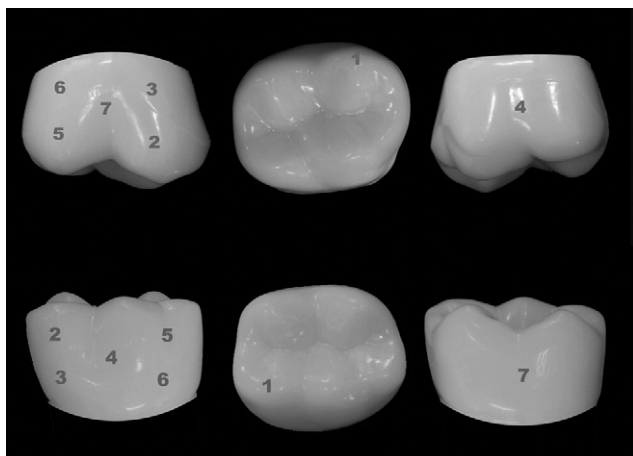


Figure 1. The 7 electrode placement sites tested.

the .01 level to determine whether the threshold at each of the 7 sites differed significantly. The 4 most responsive sites were then used to compare the differences between male and female subjects.

Results

The mean age of the subjects was 22.3 years. The 1120 EPT readings ranged from 2–67. Mean values were calculated for each site, and these ranged from 22–46. Values for the different electrode placement sites for maxillary and mandibular first molars are shown in Table 1.

The lowest response for both the maxillary and mandibular teeth was with the tester electrode on the mesiobuccal cusp tip. Other sites showed a progressive increase in threshold response level from the mesiobuccal cuspal surface, mesiobuccal gingival surface, and the center of the supporting cusps (palatal of maxillary molar, buccal of mandibular molar) (Fig. 2).

There was no significant difference between the maxilla and mandible at the mesiobuccal cusp site ($P = 0.89$) or when the readings from sites 1–4 were pooled ($P = 0.37$).

No significant difference in responses was found between male and female subjects ($P > 0.05$; Table 2; Figs. 3 and 4); however, male subjects responded at higher thresholds than female subjects on all test sites except the mesiobuccal cusp tip of the maxillary molars.

Discussion

In this experiment rubber dam was used to isolate the teeth from their neighbors and the gingivae; previous workers have relied on cotton rolls, with the teeth dried with gauze. We used a current model EPT, the electronics of which are identical to those used in previous machines and used in a study of anterior teeth (7). A narrow range of subject age aimed to avoid sensitivity variation caused by dentin deposition, pulp size reduction, and occlusal wear.

There are several considerations regarding optimal placement of the electrode in assessing the vitality of teeth. The response threshold is reached when an adequate number of nerve terminals are activated to

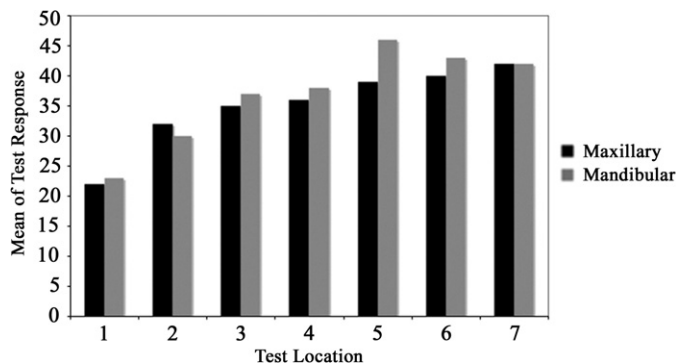


Figure 2. Mean responses for the 7 sites.

attain a so-called summation effect (1, 18). As the intensity of the stimulus increases, more sensory nerves are activated, and this results in a progressive increase in the sensory response (1). The response to a given stimulus will be greatest where the neural density is the highest. Therefore, an area of high neural density will have a relatively fast and strong response and require the least electric current (7). In permanent teeth the highest concentration of neural elements is in the pulp horns, with progressively fewer in the cervical and radicular regions of the pulp (19–21). The results of the present study confirm this, in that the response threshold increased as the electrode was moved apically from the cuspal tip to the cervical region of the tooth.

Inappropriate electric probe placement might result in a false-negative response in a tooth that is still vital. An in vitro study by Jacobson (22) determined electrode placement by using extracted incisors and premolars with measurements from an oscilloscope. He suggested the best locations for probe placement are the incisal two thirds of the labial surfaces of maxillary incisors and the occlusal two thirds of the buccal surface of maxillary premolars (22). However, his was an in vitro study, and neural density was not considered. The present experiment found no statistically significant differences in the responses of male and female subjects; previous work on anterior teeth did not consider variation between the genders (7). It also found no significant differences between maxillary and mandibular posterior teeth and is therefore in accord with at least one vitality tester manufacturer's instructions (23).

A popular conducting medium, fluoride gel, was used. An in vitro study by Martin et al (24) concluded that the medium made no appreciable difference. Conversely, a recent study of an extensive range of media available in the dental office found significant differences in conduction, but the clinical relevance is not known (25). The present experiment found the best electrode site for pulp testing first molars for diagnostic purposes. It might also be important in future studies of the effectiveness of local analgesics in which an EPT is often used (11, 12, 14–16, 26–29). Teeth with wear have a lower response threshold (7). Further research is required to evaluate worn posterior teeth and posterior teeth with restorations.

TABLE 1. First Molar Mean EPT Values

Tooth	Test Site						
	1	2	3	4	5	6	7
Maxillary (n = 20)	22	32	35	36	39	40	42
Mandibular (n = 20)	23	30	37	38	46	43	42

EPT, electronic pulp tester.

TABLE 2. Mean EPT Values, Male and Female Subjects

	Test Site			
	1	2	3	4
Maxillary, male (n = 12)	22	35	39	41
Maxillary, female (n = 8)	23	29	29	30
Mandibular, male (n = 12)	24	32	42	43
Mandibular, female (n = 8)	22	27	29	30

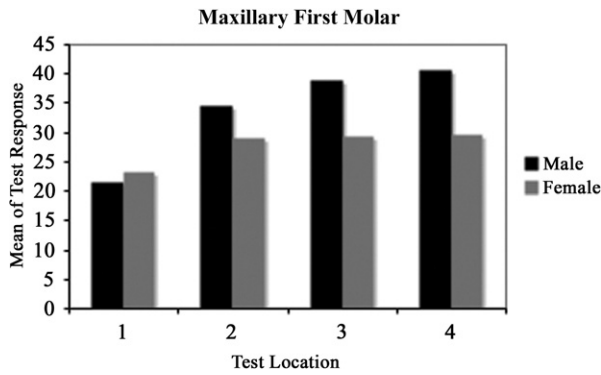


Figure 3. Male and female responses compared for sites 1–4, maxilla.

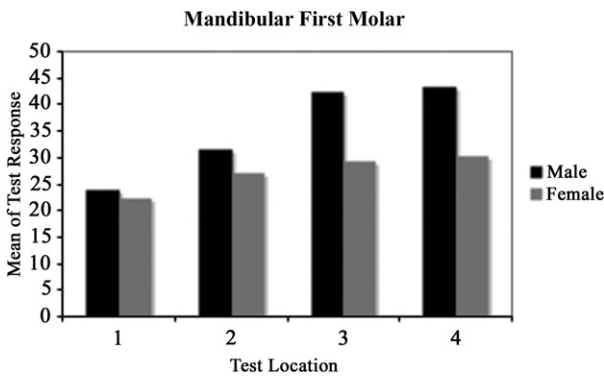


Figure 4. Male and female responses compared for sites 1–4, mandible.

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