

Original Research

Effect of fixed orthodontic brackets on pulp response to electric pulp test

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ABSTRACT:

Background: To study the effect of fixed orthodontic brackets on pulp response to electric pulp test. **Materials & methods:** A total of 20 patients (10 males and 10 females) providing 240 anterior maxillary and mandibular teeth participated. The numerical values on the EPT display were recorded at three treatment points: prior to bonding of orthodontic brackets (EPT0); immediately (5 min) after bonding and ligation of initial archwires (EPT1) and 4 weeks subsequent to initiation of tooth movement after archwire removal (EPT2). Data was collected and analysed using SPSS software. **Results:** Within the first two time points (EPT0 and EPT1) all teeth responded positively to the EPT. After four weeks, 33 teeth (13.75% of the total) failed to respond to EPT. No tooth showed the signs of pulp necrosis during the experimental period. Prior to bonding of orthodontic brackets (EPT0) the mean values for all experimental teeth was 3.45 EPT units. **Conclusion:** The physiological changes of the pulp affect the neural response in the early stages after application of orthodontic forces. **Keywords:** electric pulp test, orthodontic brackets, pulp.

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INTRODUCTION

The dental profession is yet to establish a simple, objective, standardized, reproducible, noninvasive, and accurate method to diagnose diseases of the dental pulp. Electric pulp testing is a sensitivity pulp testing method based on stimulation of sensory nerves that relies on a given patient's subjective reaction. Thus, false-positive and false-negative results should always be considered. Electric pulp testing, when properly utilized, is nevertheless safe and can provide clinical information regarding the pulp health status.¹⁻³ Electrical pulp testing (EPT) is used to acquire information about pulp vitality based on the patient's subjective sensations. There is no predictable relationship between tooth response and cellular changes within the pulp.^{4,5} In orthodontic patients where force application might have altered the physiological status of the pulpal elements, the pulp's response to electrical stimulation becomes inconsistent.^{5,6}

Intrusion is thought to have the greatest impact on the apical region during orthodontic treatment, and it may occlude the apical blood supply.^{7,8} In the literature, discussions about changes occurring in the dental pulp, in response to orthodontic intrusion, is mainly

based on experiments with animals and is controversial.^{9,10} Electrical pulp testing (EPT); a simple non-invasive test that provides the clinician with the electrical responsiveness of the pulp. This method provokes a group of fast-acting low-threshold A δ fibers, present within the pulp. EPT can be used as a sensitivity test and would provide the clinician with qualitative sensory manifestations.¹¹ Although the results of this test might be accompanied with errors, prior knowledge about the situations in which the results might get aberrant, can reduce the potential errors.¹² EPT only provides information on the status of pulpal nerves, and does not directly determine the vitality (vascularity) of pulp.¹² However, a positive response to EPT is generally interpreted as the pulp vitality. Based on the duration of the response as well as the history of the patient, the clinician can judge whether the pulp is healthy or inflamed.¹³ Changes in the physiology of the pulp might have some effects on pulpal nerves, especially A δ and A β fibers, which can cause alterations to the EPT results.^{14,15} Hence, this study was conducted to study the effect of fixed orthodontic brackets on pulp response to electric pulp test.

MATERIALS & METHODS

A total of 20 patients (10 males and 10 females) providing 240 anterior maxillary and mandibular teeth participated. The mean age was 18.45 years (with a range of 12-25 years). All cases in the study group had class I malocclusion with moderate crowding. The numerical values on the EPT display were recorded at three treatment points: prior to bonding of orthodontic brackets (EPT0); immediately (5 min) after bonding and ligation of initial archwires (EPT1) and 4 weeks subsequent to initiation of tooth movement after archwire removal (EPT2). Data was collected and analysed using SPSS software.

RESULTS

Within the first two time points (EPT0 and EPT1) all teeth responded positively to the EPT. After four weeks, 33 teeth (13.75% of the total) failed to respond to EPT. No tooth showed the signs of pulp necrosis during the experimental period. Prior to bonding of orthodontic brackets (EPT0) the mean values for all experimental teeth was 3.45 EPT units. After bonding of the orthodontic brackets and ligation of the initial archwire, the mean threshold (EPT1) of each tooth increased to 7.65 EPT units ($P < 0.001$) which was indicative of a significant decrease in the sensitivity to the test compared to EPT0 recordings. As treatment progressed, the mean EPT2 readings significantly decreased for each tooth and dropped to 5.96 units ($P < 0.001$).

Table: pulp tester values at three points

Time	Mean	p- value
EPT0	3.45	0.008
EPT1	7.65	
EPT2	5.96	

DISCUSSION

Clinical pulp testing procedures aim to stimulate a response from pulpal neural elements. Electric and thermal stimuli first evoke a response from fast-acting myelinated A fibres. With prolonged application, these electric and thermal tests will also stimulate the slow acting, relatively high-threshold, unmyelinated C fibres, but ordinarily, a pain response can be achieved before the C fibre threshold is reached.¹⁶ Hence, this study was conducted to study the effect of fixed orthodontic brackets on pulp response to electric pulp test.

In the present study, within the first two time points (EPT0 and EPT1) all teeth responded positively to the EPT. After four weeks, 33 teeth (13.75% of the total) failed to respond to EPT. No tooth showed the signs of pulp necrosis during the experimental period. Prior to bonding of orthodontic brackets (EPT0) the mean values for all experimental teeth was 3.45 EPT units. A study by Modaresi J et al, studied total of 402 anterior teeth from 39 patients (mean age of 16.8 ± 2.7 years) were examined in the non-controlled

prospective study. The aligning forces were administered using initial NiTi archwires ligated on fixed appliances by using the MBT straight wire technique. The electrical stimulation was provided by the EPT. The EPT readings were recorded at three time points: before bonding (EPT0), immediately upon initiation (EPT1) and 1 month post-treatment (EPT2). The data were statistically analyzed by the ANOVA and Bonferroni tests ($P < 0.05$). Prior to bonding of the orthodontic brackets, the mean EPT value for all the experimental teeth was 3.42 EPT units. Upon initiation, the mean value of EPT1 for each tooth increased to 7.62 units. One month later, the mean EPT2 values dropped to 6.27 units. At this time point, 64 teeth (16%) of the experimental teeth failed to respond. The differences among EPT values at different time points were significant. There was no association between the EPT values and the location or the type of teeth.¹⁷

In the present study, after bonding of the orthodontic brackets and ligation of the initial archwire, the mean threshold (EPT1) of each tooth increased to 7.65 EPT units ($P < 0.001$) which was indicative of a significant decrease in the sensitivity to the test compared to EPT0 recordings. As treatment progressed, the mean EPT2 readings significantly decreased for each tooth and dropped to 5.96 units ($P < 0.001$). Another study by Briseno- Marroquin B et al, studied an electric stimulus response threshold of eight teeth in 22 patients was measured prior to positioning orthodontic attachments, immediately before ligation of a nickel titanium archwire, immediately after ligation of a stainless steel archwire and 9 to 15 months after having achieved the clinical purposes established with the nickel titanium archwires. The mean response threshold of the second measurement showed a decreasing response threshold tendency when compared with those of the baseline measurement. The mean response threshold of the third measurement showed an increasing tendency when compared with those of the baseline measurement. Less noticeable, but similar decreasing and increasing response threshold tendencies were observed in all other teeth after the second and third measurements, respectively.¹⁸ In 1930, Ziskin and Wald reported that "There appear to be favorable frequency ranges determining thresholds of stimulation in pulp testing."¹⁹ In 1935, Kaletsky and Furedy and subsequently Markus in 1946 were among the first authors to investigate the effects of orthodontic forces on pulp vitality by means of an electric pulp tester.^{20,21} Markus reported that "the threshold of stimulation was lowered, which is indicative of pulpal irritation." He concluded that "it may be stated from the foregoing that proper and accurate pulp-testing, especially of the upper four incisor teeth, should be of value to the orthodontist to determine the status of the pulps prior to treatment, thus safeguarding the patient and the orthodontist."²¹

CONCLUSION

The physiological changes of the pulp affect the neural response in the early stages after application of orthodontic forces.

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