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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 40 patients (20 males and 20 females) providing 480 anterior maxillary and mandibular teeth participated. The mean age was 18.32 years (with a range of 13-25 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). **Results:** Prior to bonding of orthodontic brackets (EPT0) the mean values for all experimental teeth was 3.58 EPT units. After bonding of the orthodontic brackets and ligation of the initial archwire, the mean threshold (EPT1) of each tooth increased to 7.89 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 6.08 units ($P<0.001$). **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 changes.

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INTRODUCTION

Orthodontic treatment involves using fixed or removable appliances (dental braces) to correct the positions of teeth. The success of a fixed appliance depends on the metal attachments (brackets and bands) being attached to the teeth so that they do not become detached during treatment. Brackets are usually attached to teeth other than molars, where bands (metal rings that go round each tooth) are more commonly used. (1)

The dental pulp is sensitive to external factors such as microbial infection from dental caries and/or mechanical/chemical irritations during dental procedures. Dental tissue behaves differently to the other connective tissues. It is unique in a way that its soft tissues (pulp and pulp-dentin complex) are enclosed within mineralized hard tissues (enamel, dentin, and cementum), and its pulp is supplied by a rich neurovascular network that regulates various inflammatory mediators. (2,3) Inflammatory signals may progress to rapid degeneration and necrosis, and such events could inflict very serious damage to tissues in the body. (4,5)

Factors that induce inflammation in the dental pulp and the root apex are as follows the ingression of microorganisms through dental caries, crack or dentinal tubules of the teeth; chemical irritation from etching and/or bonding materials for adhesion of dental materials; mechanical irritation during preparation in restorative procedures; trauma from occlusion (TFO) or orthodontic movement of the teeth. Such factors may initiate the inflammatory cascades, which, in turn, further progress to pain and root resorption via neurogenic inflammation and hard tissue remodeling. (6,7) Hence, the study was conducted to analyse the effect of fixed orthodontic brackets on pulp response to electric pulp test.

MATERIALS & METHODS

A total of 40 patients (20 males and 20 females) providing 480 anterior maxillary and mandibular teeth participated. The mean age was 18.32 years (with a range of 13-25 years). All cases in the study group had class I malocclusion with moderate crowding. Other inclusion criteria were: the need for non-extraction fixed orthodontic treatment, no systemic diseases, healthy periodontium and sound dentition, no endodontically treated teeth, positive initial EPT responses before orthodontic treatment and no previous removable orthodontic appliances. 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, 68 teeth (14.2% 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 3.58 EPT units. After bonding of the orthodontic brackets and ligation of the initial archwire, the mean threshold (EPT1) of each tooth increased to 7.89 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 6.08 units (P<0.001).

Table: Pulp tester values at three points

Time	Mean	p- value
EPT0	3.58	0.006
EPT1	7.89	
EPT2	6.08	

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. [8] Our study showed that within the first two time points (EPT0 and EPT1) all teeth responded positively to the EPT. After four weeks, 68 teeth (14.2% of the total) failed to respond to EPT. No tooth showed the signs of pulp necrosis during the experimental period.

One of the study showed, 47 subjects who required fixed orthodontic appliances were used as a study group with 23 non-orthodontic subjects recruited as a control group. The numbers of negative responses for each tooth at each time interval were recorded for both groups. The data were collected and tabulated, and chi-square tests were used to determine significant difference between the numbers of negative responses for the two types of tests used on the same tooth and between different teeth. The mean values of the electric pulp testing (EPT) thresholds were also obtained and used to assist in analysing the results. [9] Prior to bonding of orthodontic brackets (EPT0) the mean values for all experimental teeth was 3.58 EPT units. After bonding of the orthodontic brackets and ligation of the initial archwire, the mean threshold (EPT1) of each tooth increased to 7.89 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 6.08 units (P<0.001).

In the control group, all teeth tested positively to the EPT and thermal pulp tests at all time intervals. In the orthodontic group, two teeth failed to respond to EPT and only one tooth to thermal testing at baseline (Time 0). After that, the number of negative responses to both tests increased gradually at each time interval reaching a peak after 2 months of active treatment (Time 3) and then declined gradually towards the end of observation period (Time 14). At baseline, response thresholds to electric testing were typically higher for orthodontic subjects, particularly for the maxillary lateral incisor tooth. For the control group, the response threshold over the study period was relatively constant. For the orthodontic group, application of force immediately increased the response threshold to EPT (Time 1), which peaked after 2 months (Time 3) and then gradually reduced. At the end of the active treatment, response thresholds remained elevated, but they returned to pre-treatment values towards the end of the retention phase. [10,11]

Another study showed, a total of 402 anterior teeth from 39 patients (mean age of 16.8±2.7 years) were examined in this 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. [12] 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. [13]

CONCLUSION

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

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