The effect of orthodontic tooth movement on the sensitivity of dental pulp.

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Abstract

Objective: The aim of this study was to recognize pulp sensitivity changes in teeth of subjects receiving orthodontic treatment by means of an electric pulp tester.

Materials and methods: Before placing orthodontic attachments, immediately before ligating a nickel titanium archwire, immediately after ligating a stainless steel archwire, and 9 to 15 months after achieving the clinical goals established with the nickel titanium archwires, an electric stimulus response threshold of 8 teeth in 100 patients was measured. The initial measurement served as a starting point.

Results: At all times, teeth responded to an electrical stimulus. The response thresholds achieved at various treatment times showed no statistically significant variations. When compared to those of the baseline measurement, the mean response threshold of the second measurement had a tendency to decrease. When compared to those of the baseline

measurement, the mean response threshold of the third measurement displayed an increasing tendency. After the second assessment, the first maxillary incisor and canine showed the lowest decreasing response threshold and the highest increasing response threshold. All other teeth showed similar, but less obvious, decreasing and increasing response threshold tendencies after the second and third assessments, respectively.

Conclusions: it was concluded that pulp sensitivity can be monitored during orthodontic treatment by means of an electric pulp tester.

Keywords: Electric pulp tester, Pulp sensitivity, Orthodontic treatment, Orthodontic forces.

Introduction

Orthodontic tooth movement (OTM) is a biological process, which starts with the application of mechanical, orthodontic force on the tooth and is carried out through the mechanisms of the periodontal ligament and alveolar bone [1]. The cascade of local signaling mediators elicit resorptive changes on the pressure side and apposition of alveolar bone on the tension side. Unlike processes in the periodontal ligament and alveolar bone, processes in the dental pulp aren't as well studied and documented [[2], [3], [4]].

The dental pulp is a specialized, well-vascularized and richly innervated soft connective tissue, which is located in the dental pulp chamber, its furcations and root canals enclosed by hard dental tissues [5]. The main functions of the dental pulp are structural (synthesis of dentine), trophic (blood and lymphatic vessel supply), protective (synthesis of reparative dentine), and sensory (innervation) [[6], [7], [8]]. Limitations due to the morphology and physiology of the dental pulp - clinical evaluation of the dental pulp that is objective, quantifiable and has a biological basis is difficult to obtain [9].

Hence, this study was conducted to assess the effect of orthodontic treatment on dental pulp.

Material and methods

8 teeth from each patient, including the incisor, canine, premolar, and molar groups, were chosen for evaluation with an electric pulp tester (Vitality Scanner Model 2006; Kerr Corpora). These teeth were 11, 13, 15, and 16 (8, 6, 4, and 3 in the American Dental Association Universal Numbering system, respectively) from the first quadrant and 31, 33, 35, and 36 (24, 22, 20, and 19 in the third quadrant, respectively). A periodontal probing depth greater than 3 mm, radiographic bone loss, endodontically treated teeth, a history of

trauma, previous orthodontic treatment, those scheduled for maxillofacial surgery, serious systemic disease, medication, pregnancy, radiographically discernible, incomplete root development, and a history of trauma were among the exclusion criteria.

Following the oral diagnostic, the pre-selected teeth were isolated using a cotton roll, their surfaces were dried by air drying, a conductive material (toothpaste) was applied, and the probe tip of the electric pulp tester was used to conduct the measurement. In order to assure the accuracy of the measurement and the information collected, the buccal surface of each tooth was divided into six squares, with one of them being chosen for the electric measurement. The area chosen for the baseline and subsequent measurements was designed so that there could be no possibility of contact between the electric probe tester-tip or the conductive media and adjacent tissues and/or archwire, preventing an electric impulse from being conducted to the adjacent teeth.

The electric pulp tester's panel wheel was always set to 3. Automatic activation of the electric pulp tester followed by stable contact between the probe and the tooth. The electrical stimulus's strength automatically increased. Patients were encouraged to signal with their hand or voice once they had seen the stimulus that the probe had communicated. The appropriate unit reading (ranging from 0 to 80) was protocoled.

Results

60 out of 100 enrolled patients (14 to 36 years of age ± 6.39; 40 females, 20 males) completed the orthodontic treatment. A total of 400 baseline and second and third electric pulp tester measurements were made. The time span between the $2^{nd}$and 3^{rd}measurements was between 9 and 15 months.

Table 1: gender-wise distribution of subjects.

Gender	**Number of subjects**	**Percentage**
Males	40	40%
Females	60	60%
Total	100	100%

Table 2: Descriptive analysis of an electric pulp tester unit readings of pre-selected teeth from 100 patients obtained during active orthodontic treatment

	Age	**Tooth 11-8/meas.**			**Tooth 13-6/meas**		
		1st	**2nd**	**3rd**	**1st**	**2nd**	**3rd**
Mean	20.63	30.29	31.77	33.85	34.07	34.09	35.86

No statistically significant differences were observed between the investigated groups.

Discussion

The influence that orthodontic forces can have on cementum hardness and elastic modulus [10], root resorption induction, or pulp tissue changes [11,12,13] has been reported in the literature. Based on the scientific evidence and clinical perspectives, one can speculate that the dental pulp vitality during orthodontic treatment could be compromised, depending on the degree and time duration of the applied orthodontic forces on the involved teeth. An investigative model, therefore, was designed with the expectation that if the application of orthodontic forces would produce pulp tissue changes, they could be perceived by means of an electric pulp tester. Complete innervation of the dental pulp should be completed 4 to 5 years after eruption [14], even if the apex appears radiologically completely formed [15]. Bender et al. [16] suggested that a pulp stimulus response threshold correlates with its neural density. It can therefore be expected that younger pulps will respond with a higher stimulus amount.

Hence, the study was conducted to assess the effect of orthodontic treatment on dental pulp.

In this study, 60 out of 100 enrolled patients (14 to 36 years of age; 40 females, 20 males) completed the orthodontic treatment. A total of 400 baseline and second and third electric pulp tester measurements were made. The time span between the 2nd and 3rd measurements was between 9 and 15 months.

The electric pulp tester employed in this investigation is clinically readily available, possesses an integrated, automatic stimulus intensity increase unit scale, and is easy to operate. Electric pulp tester literature communications are contrasting; it has been reported that the threshold sensation it produces is not painful [17], that it is an efficient and trustable pulp sensitivity testing method [18–20] with a similar reliability as cold pulp testing [21], and that the subjective pain ratings and the increment of pulp sensitivity measured with an electric pulp tester can be correlated [22]. Nevertheless, significant differences between the electric and cold tests by means of the VAS scale have been reported [23].

The mean response thresholds—measured immediately after ligation of the initial nickel titanium archwire—increased in all teeth groups. These results are in accordance with the results obtained by different authors [24, 25, 26, 27].

Conclusion

It was concluded that pulp sensitivity can be monitored during orthodontic treatment by means of an electric pulp tester.

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