

## **Frequencies of Root Canal Treatment and Deep Caries in Clear Aligner compared To Conventional Orthodontic Treatment: A Retrospective Cohort Study**

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### **Abstract**

#### **Introduction**

The impact of orthodontic forces on human pulpal tissues has been the subject of interest with an unpredictable result. These changes range from an inconsequential alteration in the pulp vasculature to a deplete in the respiration rate of the pulpal tissue. Moreover, the nature, direction and expanse of orthodontic appliances forces exerted during tooth movement, the maturity of root apices and patient's age may all influence a change on human pulpal tissues.

#### **Aim**

Purpose of the study was to determine which orthodontic appliance has higher frequencies of root canal treatment and deep caries that affect pulp vitality during the

#### **Materials and Methods**

A retrospective study using the patient electronic files (pre-operative and post-operative radiographs including patient treatment records).

#### **Results**

It can be observed from the findings that there was no statistically significant difference between Invisalign and conventional orthodontic treatment as far as caries incidence was concerned.

#### **Conclusion**

The overall prevalence of caries among orthodontic patients was 24% but there was no significant difference between Invisalign and conventional orthodontic treatments.

**Keywords-** Caries, invisalign, orthodontics, clear aligner

### **Introduction**

The declaim focused question, that is related to PICO, was "Does human dental pulp vitality will be affected by orthodontic treatment?" (1). The impact of orthodontic forces on human pulpal tissues has been the subject of interest with an unpredictable result. These changes range from an inconsequential alteration in the pulp vasculature to a deplete in the respiration rate of the pulpal tissue (2). Moreover, the nature, direction and expanse of orthodontic appliances forces exerted during tooth movement, the maturity of root apices and patient's age may all influence a change on human pulpal tissues. A diversity of outcome measures has been used to dictate the effect of orthodontic tooth movement on the pulp, encompassing the effects at the tissue level (inflammation of pulp, degeneration, cellularity, fibrotic changes, predentine width, formations of reparative dentine, obliteration of pulpal space, Hertwig's epithelial root sheath) (3). The

effect of treatment on the dental pulp are of particular interest to the orthodontist. Alteration to pulpal physiology may lead to altered responses to external stimuli. Several studies have evaluated the impact of orthodontic force on dental pulp; however, they reported leads to the literature are inconsistent and inconclusive, mostly because of methodological limitations. One among few studies of human pulpal tissue obtain from teeth subjected to orthodontic force suggests that pulpal respiration rates are on the average reduced in early stage of the applying of orthodontic force (4-6). Although the state of maturity of the apex is also a modifying factor and teeth with incomplete apical foramina may demonstrate an increased respiration rate. Some studies have reported short term effect like changes in tissue respiration (7,8) and have reported lasting consequences like necrosis (8,9).

The demand for clear aligners is increasing nowadays due to its esthetic demand for those patients who are indisposed of wearing usual orthodontic appliances. Clear aligners are thin transparent removable hidden plastic for the effective moving of teeth into their required position. They conventionally are worn for a minimum of 20 hours per day and are changed sequentially every two weeks (10).

A recent study done in Abha, Saudi Arabia reported that Invisalign orthodontic treatment was associated with less negative oral health effects in comparison to conventional among females but not among males. Impact of personality profiles towards the impacts of Invisalign treatment on oral health related quality of life was different between genders. Personality characteristics and factors; openness before treatment and extraversion, honesty, and diligence after treatment, were related to and able to foresee oral health impacts of Invisalign orthodontic treatment among males (12).

### **Objectives**

The aim of the study was to determine which orthodontic appliance has higher frequencies of root canal treatment and deep caries that affect pulp vitality during the treatment period.

### **Materials and Methods**

#### **Study Design**

A retrospective study using the patient electronic files (pre-operative and post-operative radiographs including patient treatment records).

#### **Study Instrument**

This descriptive retrospective study involved retrieving electronic files stored on the clinical software system (Dentopius) used at Riyadh Elm University from the orthodontic post graduate clinic. Five-hundred files were reviewed from REU database, out of which only 100 files were included in our study based on our inclusion criteria (50 conventional orthodontics and 50 clear aligners). Extracted data included patient's age, treatment records and the radiographs taken during the standard data collection phase. The radiographs were taken utilizing a digital imaging system. The electronic records selected were those of patients aged 14–40 years. Presence of pre-operative and post-operative radiographs was an inclusion criterion. In which was observed the increase frequency of caries and root canal treatment. However, patients with pre-operative radiographs only were excluded from the study. Information was obtained from the radiographs and in addition to the notes in the files. Inter-examiner reliability testing was conducted prior to reviewing the files.

**Statistical Analysis:**

A descriptive statistic of mean and standard deviations values was calculated for the dental and periodontal variables. Normality was assessed and the data was found to be not normally distributed. Hence non-parametric test of Mann-Whitney U was applied to compare the variables between aligner and conventional orthodontic treatment. A value of  $p < 0.05$  was considered significant for all statistical analyses. All the data was analyzed by using IBM-SPSS (Version 22).

**Ethical Consideration:**

Ethical approval was obtained from REU Research center (Institutional Review Board).

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**Results:**

Data were inserted into SPSS version 22, which revealed descriptive as well as inferential findings presented in the tables below. Table 1 shows the descriptive statistics including the means and standard deviation values, which are 1.5 for type of orthodontic treatment and 1.76 for change noticed in OPGs with .502 and .429 standard deviation, respectively.

Table 2 shows the frequencies of orthodontic treatment type, which is 50% each. Table 3 shows the changes noticed in the post OPG, which revealed 24% yes and 76% as no. Table 4 exhibits the cross-tabulation between type of orthodontic treatment and changes observed in OPGs, which shows that 10 out of 50 Invisalign patients had changes, with 14 out of 50 having conventional treatment experiencing the same. However, this difference was not statistically significant when compared using Chi-square and Mann-Whitney U tests (Table 5 and 6 respectively).

**Statistics**

		Type	Change
N	Valid	100	100
	Missing	0	0
Mean		1.5000	1.7600
Std. Error of Mean		.05025	.04292
Median		1.5000	2.0000
Std. Deviation		.50252	.42923
Skewness		.000	-1.236
Std. Error of Skewness		.241	.241
Kurtosis		-2.041	-.482
Std. Error of Kurtosis		.478	.478
Minimum		1.00	1.00

Table 1: Descriptive statistics of the collected data.

**Type of Orthodontic Treatment**

		Frequency	Percent	Valid Percent	CumulativePercent
Valid	Invisalign	50	50.0	50.0	50.0
	Conventional	50	50.0	50.0	100.0
	Total	100	100.0	100.0	

Table 2: Frequencies of the two groups of subjects.

**Change Noticed in OPGs**

		Frequency	Percent	Valid Percent	CumulativePercent
Valid	Yes	24	24.0	24.0	24.0
	No	76	76.0	76.0	100.0
	Total	100	100.0	100.0	

Table 3: Change noticed in OPGs of included cases.

**Type \* Change Crosstabulation**

Count

		Change		Total
		Yes	No	
Type	Invisalign	10	40	50
	Conventional	14	36	50
	Total	24	76	100

Table 4: Cross tabulation orthodontic treatment type with change noticed in OPGs.

**Chi-Square Tests**

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.877 <sup>a</sup>	1	.349		
Continuity Correction <sup>b</sup>	.493	1	.482		
Likelihood Ratio	.880	1	.348		
Fisher's Exact Test				.483	.241
Linear-by-Linear Association	.868	1	.351		
N of Valid Cases	100				

a. 0 cells (.0%) have expected count less than 5. The minimum expected count is 12.00.

b. Computed only for a 2x2 table

Table 5: Chi-square test values.

Ranks				
	Change	N	Mean Rank	Sum of Ranks
Type	Yes	24	54.67	1312.00
	No	76	49.18	3738.00
	Total	100		

Test Statistics <sup>a</sup>	
	Type
Mann-Whitney U	812.000
Wilcoxon W	3738.000
Z	-.932
Asymp. Sig. (2-tailed)	.351

a. Grouping Variable: Change

Table 6: Mann-Whitney U test to compare the means of both samples.

### Discussion:

This study aimed to assess the effect of conventional and Invisalign orthodontic treatments on the incidence of dental caries. It can be noted from the findings that only 24 patients exhibited caries during their orthodontic treatment, out of which 10 cases underwent Invisalign and remaining 14 had conventional orthodontic treatment. This is expected as orthodontic treatment is associated with certain problems including dental caries (13). This is further supported by another study which suggested that injury from orthodontic forces might be long-lasting, and the pulp could ultimately lose its vitality. Nevertheless, other studies showed that orthodontic forces had no significant permanent effects (14). The physiological changes of the pulp alter the neural reaction in the early stages after application of orthodontic forces. Response thresholds to electrical stimulation are also risen and subsequently the EPT may not commence a reaction. The pulpal response during orthodontic treatment is anticipated from many factors such as Pulpal anatomy, microvasculature & epidermal growth factors (15).

It can be observed from the findings that there was no statistically significant difference between Invisalign and conventional orthodontic treatment as far as caries incidence was concerned. Similar findings were reported by Wang et al. (2019) who reported that both fixed and Invisalign orthodontic treatments ended in dysbiosis of the oral microbiome. From the microbiome makeup and functional attributes, the Invisalign system did not indicate improved performance contrasted with fixed appliance treatment. Thus, giving no statistically significant effect on the incidence of caries or any other oral disease (16).

As mentioned above, a study conducted in Abha revealed that caries prevalence was less among the patients treated with Invisalign as compared to conventional orthodontic treatment (12). On the other hand, our study did not find a significant comparison between caries incidence and types of treatment. Moreover, they compared the findings on the basis of gender as well, but no such difference was measured in our study.

**Conclusion:**

The overall prevalence of caries among orthodontic patients was 24% but there was no significant difference between Invisalign and conventional orthodontic treatments.

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