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Comparison of Abundance of Premolar and Molar Pulp Stones Before and After Orthodontic Treatment Using Panoramic Radiography

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A B S T R A C T

Objectives: Pulp stone is a focal calcification in dental pulp, which is often detected on conventional dental radiographs. Pulp stones can complicate easy access to the root canal and pulp chamber in root canal treatment. Orthodontic treatment may be associated with the formation of pulp stones. Therefore, this study examined the number of pulp stones pre- and post-orthodontic treatment.

Materials and Methods: In this retrospective cross-sectional comparative study, 222 digital panoramic radiographs collected from private orthodontic offices in Rasht, were divided into two groups: radiographs of patients undergoing orthodontic and non-orthodontic treatment according to the inclusion criteria. The obtained data were analyzed by SPSS via the Wilcoxon and Mann-Whitney tests ($P<0.05$).

Results: The difference in the number of pulp stones pre- and post-orthodontic treatment was significant ($P<0.0001$). The maximum number of pulp stones after orthodontic treatment was observed in second molars ($P=0.016$). The change in the number of pulp stones in the mandible ($P=0.001$) was significantly higher than that in the maxilla ($P=0.002$). This change was also greater in the left side ($P<0.0001$) than in the right side ($P=0.002$). The changes in the number of pulp stones was significant in females ($P=0.02$). Age had an insignificant effect on pulp stone formation ($P>0.05$).

Conclusion: This study showed the effect of orthodontic treatment on the number of pulp stones. Further studies are required to clarify the underlying mechanisms for this increase and come up with strategies to prevent it.

Keywords: Dental Pulp Calcification; Radiography, Panoramic; Radiography, Dental, Digital; Orthodontics, Corrective

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INTRODUCTION

With the increased awareness about oral health, orthodontic treatment has gained increasing popularity among the children, adolescents, and adults to achieve optimal esthetics and improve the oral health-related quality of life. Maintaining oral hygiene and regular follow-ups are necessary during orthodontic treatment. However, most patients require periodontal, restorative or root canal treatments after orthodontic treatment [1]. Appropriate access to the root canal is desirable in root canal treatment, and calcified tissue in the root canal system is a challenge encountered during endodontic treatment [2].

Pulp stones are calcified foci in the dental pulp, which need to be removed. Pulp stones may be either-true calcified tissues made up of dentin and lined by odontoblasts, or false calcified tissues formed by degenerated cells following pulp mineralization [3]. The exact cause of pulp stone formation is still unclear, but it may be caused by degenerative changes in the pulp, induction effect between pulp tissue and epithelium, and blood circulation problems. The risk factors for the pulp stones include aging, continuous stimulation of dental pulp due to caries, tooth restoration, or forces applied to the teeth, genetics, and idiopathic factors [4]. Pulp stones may be present in one or all teeth and can even be found in unerupted and impacted teeth [3]. They may be located in the pulp chamber or the root canals [6].

The ones located in the root canals are usually narrow and prevent access to the apical region during root canal treatment, and may lead to endodontic treatment failure and even tooth loss [5]. Radiographically, the pulp stones are opaque, round or oval, small or large masses [6].

The pulp tissue irritation caused by orthodontic treatment may be similar to that caused by some restorative treatments, such as indirect pulp capping [4]. Forces applied by orthodontic appliances cause changes in the pulp tissue such as shrinkage of the pulp chamber due to secondary dentin formation, internal root resorption, cyst formation, pulp calcification, and pulp necrosis [7,8].

The results of a study on the correlation of orthodontic treatment and pulp stone formation showed variations in the prevalence of pulp stones based on race, age, sex, and type of teeth [3].

The obtained data from some previous studies are inconsistent with the role of orthodontic treatment as a possible risk factor for pulp stone formation [3,9, 10], which could be attributed to the study design, data collection, and presence/absence of a control group. A previous study on pulp stones after orthodontic treatment reviewed the effect of short-term orthodontic treatment using panoramic radiographs [11].

This study aimed to assess the frequency of pulp stones on panoramic radiographs of patients pre and post fixed orthodontic treatment.

MATERIALS AND METHODS

In this retrospective, comparative study, 222 panoramic radiographs of patients referring to private orthodontic clinics in Rasht during 2015 to 2017 were collected according to the eligibility criteria using convenience sampling (ethical approval: IR.GUM.REC.1396.428).

In this study, 74 patients were in the non-orthodontic group and 148 patients were under fixed orthodontic treatment. The inclusion criteria for patients undergoing orthodontic treatment included: Being under orthodontic treatment for the past 2 years (2015-2017), availability of their pre- and post-treatment panoramic radiographs in their record, age range of 18 to 30 years, and no history of trauma, periodontal treatment, root canal treatment or restorative treatments in premolars and molars. Patients with cleft palate, atherosclerosis, gout, gigantism and/or acromegaly, Paget's disease, hypercementosis, Ehlers-Danlos syndrome, torus, calcinosis universalis, or dentin dysplasia were excluded from the study.

The inclusion criteria were the same for the non-orthodontic group, and the difference was that the non-orthodontic group was not under orthodontic treatment during the study period (2015-2017), and had two panoramic radiographs taken at the beginning and at the end of this time period. The radiographs were evaluated by a magnifying glass on a single negatoscope by a senior dental student under the supervision of an oral and maxillofacial radiologist. Radiographs were numbered to avoid bias. The patient information such as age, gender, history of trauma, and dental treatments were collected from their records. All data were entered into SPSS version 21.

The Wilcoxon test was used to compare the number of pulp stones pre- and post-treatment, and the Mann-Whitney test was used in order to compare the frequency of pulp stones between the two groups. $P<0.05$ was considered significant.

RESULTS

In the present study, 222 panoramic radiographs of 141 females and 80 males were evaluated for the presence of pulp stones. Among the radiographs, 148 of them belonged to patients under orthodontic treatment and 74 to the non-orthodontic group. Comparison of the number of pulp stones pre- and post orthodontic treatment by the Wilcoxon test showed significantly higher number of pulp stones in the orthodontic group (P<0.00; Table 1).

Table 1. Comparison of changes in the number of pulp stones after 2 years, in the orthodontic and non-orthodontic groups

Groups	Change	N(%)	Mean	P
Orthodontic	Increase	21(14.18)	11	<0.001
	None	127(85.8)		
Non-orthodontic	Increase	2(2.70)	1.5	0.157
	None	72(97.29)		

Changes in the number of pulp stones in different teeth were also evaluated. According to the results obtained in the present study, the second molars (P=0.016) in both groups had the highest increase in the number of pulp stones after two years. However, the changes were significantly greater in the group that received orthodontic treatment (P=0.016).

The increase in the number of pulp stones was significant in the first molar (P=0.023) and second molar (P=0.002) teeth (Table 2) in the orthodontic group. On the other hand, in the non-orthodontic group, the increase in the number of pulp stones after treatment was not significant in any of the teeth.

The change in the number of pulp stones in the group who received orthodontic treatment was significant in both jaws with P-values of P=0.001 and P=0.002 and in the mandible and maxilla, respectively.

In the orthodontic group, the change in the number of pulp stones was significant after 2 years in both the left (P<0.000) and the right (P=0.002) sides. Comparison of changes in the orthodontic group revealed that maximum change had occurred in the left side (P=0.002, Table 3).

The changes in pulp stone number after treatment were only significant in females (P=0.02). The correlation of pulp stones with

Table 1. Comparison of changes in the number of pulp stones after two years according to the tooth type

Groups			N	Percentage of frequency change	Mean	P
Orthodontic	**First molars**	Increase	6	4.05	3.5	0.023
		None	142	95.94		
	Second molars	Increase	44	7.43	6	0.002
		None	137	92.56		
	First premolars	Increase	2	1.35	1.5	0.157
		None	146	98.64		
	Second premolars	Increase	3	2.02	2	0.102
		None	145	97.97		
Non-orthodontic	**First molars**	Increase	2	2.7	1.5	0.157
		None	72	97.29		
	Second molars	Increase	0	0	0	0.999
		None	74	100		
	First premolars	increase	0	0	0	0.999
		None	74	100		
	Second premolars	Increase	0	0	0	0.999
		None	74	100		

Table 2. Comparison of the changes in the number of pulp stones after two years in the maxilla and mandible and left and right sides in the two groups

Groups			N	Percentage of frequency change	Mean	P
Orthodontic	Maxilla	Increase	11	7.4	6	0.002
		No change	137	92.56		
	Mandible	Increase	13	8.7	7	0.001
		No change	135	91.21		
	Right	Increase	10	6.75	5.5	0.002
		No change	138	93.24		
	Left	Increase	18	12.16	9.5	0.001
		No change	130	87.83		
Non-orthodontic	Maxilla	Increase	1	1.35	1	0.317
		No change	73	98.64		
	Mandible	Increase	1	1.35	1	0.317
		No change	73	98.64		
	Right	Increase	2	2.7	1.5	0.157
		No change	72	97.29		
	Left	Increase	0	0	0	0.999
		No change	74	100		

age, analyzed by the Spearman's correlation coefficient, was poor in both the orthodontic group (r=0.026, P=0.753) and in the non-orthodontic group (r=0.096, P=0.416) (Table 4).

Table 4. Comparison of the changes in the number of pulp stones after two years according to gender

Sex	Groups	N	Frequency change(%)	Mean	P
F	Orthodontic	67	65.37	74.16	0.02
	Non-orthodontic	46	32.62	64.48	
	Total	141	100		
M	Orthodontic	52	65	41.38	0.32
	Non-orthodontic	28	35	38.88	
	Total	80	100		

DISCUSSION

The forces applied to the teeth during orthodontic treatment may lead to the formation of pulp stones. In this retrospective comparative study, 222 panoramic radiographs of patients referring to dental clinics of Rasht from 2015 to 2017 were evaluated to examine the presence of pulp stones pre- and post-orthodontic treatment. In the present study, we used panoramic radiography before, during and after orthodontic treatment similar to the studies by Ertas et al, [4] Gaddalay et al, [12] and Dalili et al [13].

Our findings were similar to the findings of Ertas et al, [4]and Lazzaretti et al, [8] showing that fixed orthodontic treatment can increase the frequency of pulp stones, which contradicts the results of Ramazanzadeh et al [11]. The reason could be the application of interrupted intrusive and extrusive forces for three days with three-week intervals.

In the study by Gaddalay et al, [12] pulp stones were found more commonly in the left side, which does not agree with the study by Turkal et al, [3] which could be due to the demographic variations between the Iranian and Turkish populations, as well as the different age range of patients in the two studies. In this study, pulp stones were more frequent in the mandible, which is compatible with the finding of Gaddalay et al, [12] but

does not agree with the findings of Ertas et al, [4] Ravanshad et al, [10] and Turkal et al [3]. The cause of this difference in the study of Dalili et al. [13] could be due to the age under 65 and in the study of Kuzekanani et al. [14] could be genetic variations. Turkal et al, [3] and Han et al. [5] evaluated the images on a monitor rather than evaluating the printed radiographs to identify pulp stones; while Ramazanzadeh et al. [11] used bitewing radiographs.

Age had an insignificant effect on the frequency of pulp stones, which agrees with the results of Ertas et al, [4] but disagrees with the finding of Dalili et al [13]. It could be due to the short intervals between the radiographs, which was not sufficient for pulp stone formation and their young population. The results of the current study are consistent with the data reported by Gaddalay et al, [12] Ertas et al, [4] and Ravanshad et al, [10] in terms of the frequency of pulp stones in females, which was more than that in males.

Future studies with larger sample size are required in order to determine the frequency of pulp stones after orthodontic treatment. Bitewing and periapical radiography are better modalities for identifying the change in the number of pulp stones on a monitor or negatoscope. Knowing the fact that in this study diseases predisposing to pulp stones were not evaluated, future studies should be performed to examine the impact of such diseases. According to the results, second molars experienced greater increase in the number of pulp stones after orthodontic treatment, but it could not be specified that the force was exclusively applied to this tooth or not; this topic needs to be addressed in future studies.

CONCLUSION

Fixed orthodontic treatment can cause an increase in the frequency of pulp stones, complicating the root canal treatment of such teeth. Therefore, maintenance of oral hygiene during orthodontic treatment is highly important to minimize the need for root canal therapy after orthodontic treatment.

CONFLICT OF INTEREST STATEMENT

None declared.

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