Original Article

Prevalence Of Pulp Stones After Orthodontic Treatment - A Review

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Abstract

The presence of various forms of calcification within the pulp is not rare but the frequency of this calcification is difficult to estimate. Pulp stones are pulpal calcification thought to arise around the central nidus of the pulp tissue, survival of which depends upon continuous blood supply.

This review paper aims to discuss the correlation between orthodontic treatment and pulp stone formation. Various studies were conducted and it was found that a significant increase in pulp stone was present at the end of orthodontic treatment. Maxillary 1st molar has exhibited the highest frequency in the occurrence of pulp stones followed by maxillary 2nd molars and mandibular 1st molars. There is a statistically significant difference between the incidence of pulp stones in maxillary and mandibular arches during orthodontic treatment. So far no relation has been detected between pulp stones and gender and between pulp stones and right and left sides of both the arches. Based on the studies, Orthodontic treatment might lead to pulp stone formation. This is attributed to the fact that orthodontic forces might alter the blood supply and vascular pressure leading to calcifications.

Key words: Pulp stone, Orthodontic tooth movement, Calcifications

Introduction: Dental pulp tissue is the non-mineralized portion of the tooth that receives a continuous and unhindered blood supply. Damage to the pulp might result from a lack of or change in blood flow. As a result, vascular tissue pressure must be maintained at a consistent level.[1]

In response to any surgical or chemical stimulation, tooth pulp tissue may form dentin or osteopontin to maintain homeostasis. The calcification of the pulp tissue depends on the action of pulp cells.[2]

Pulp stones are calcified entities, which occur, in the dental pulp. Denticles or nodules are other names for pulp stones. The pulp chamber and radicular pulp space shrink symmetrically as a result of diffuse calcification.[3] Pulp stones can be detected in teeth that are healthy, diseased, or even unerupted. They have a calcium-to-phosphorus ratio that is comparable to that of dentin.[4,5] They're more common

in the coronal section of the pulp chamber than in the radicular canal. They appear radiographically as radio-opaque lumps inside a radiolucent pulp chamber.[4]

Classification and Formation: Both permanent along with deciduous dentitions can possess pulp stones. They can even be present in unerupted teeth.[1] The pulpal tissue can be found in 2 different forms i.e. clustered, which is usually found in the pulp chamber and can be attached or unattached to its wall, or diffuse which is located near the apices of the tooth arbitrarily.[6-9]

Kronfeld defined pulp stones as either 'real' or 'false,' with the former possessing irregular dentine and the latter degenerative pulp calcifications as described in **Table 1**.[6]

Table 1: Classification of pulp stones

Structure	1. True	Made of dentin and are lined by odontoblast
	2. False	Made of degenerating cells of pulp
	3. Diffuse	Usually found in close association with blood vessels. More irregular than false pulp stone
Location	1. Embedded	Enclosed in canal walls due to ongoing dentin formation
	2. Adhered	Not completely enclosed by dentin
	3. Free	Found within the pulp tissue

True pulp stones arise from dentine and are bordered by odontoblast, whereas false pulp stones are created by the mineralization of degenerating pulp cells.
Mineralization takes place in stages:
Stage 1 - cell nests are encircled by concentrically structured fibers which are subsequently impregnated with mineral salts.
Stage 2 - calcified increments are added.[7]

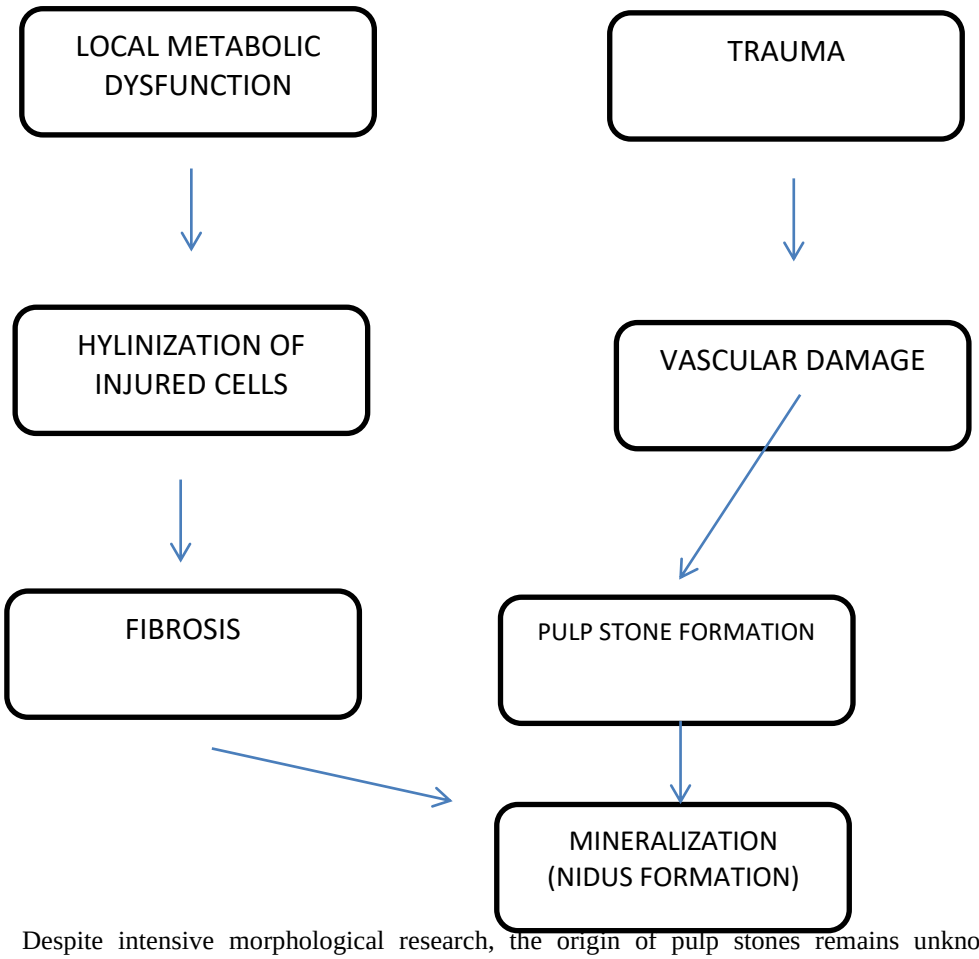
Pulp stones can be embedded, adhering, or free, depending on their location.6 Embedded stones occur in the pulp, but as the dentine continues to form, they get trapped (sometimes completely) within the canals. They are usually seen in the apical section of the root, and odontoblasts and calcified tissue that resembles dentine can be found on the periphery of these stones.[8] Adherent pulp stones are usually not linked to dentine, unlike embedded pulp stones. Usually, adherent stones are not surrounded by dentine. Free pulp stones are the most prevalent form on radiographs and are seen within the pulp tissue itself. They are fairly abundant and range in diameter from 50 µm to several millimeters, occluding the whole pulp chamber.[9]

The particle could be as small as an individual microscopic particle or as large as a massive mass capable of fully obliterating the pulp chamber.[10] They're much more common in the pulp chamber than in the root canal, and they can affect a single tooth or a group of teeth.[11]

Pulp stones can be seen in the root canals due to the spread from the pulp chamber or as a single dense mass or a series of tiny radiopacities within pulp chambers or root canals.[12-14]
On radiography, pulp stones appear as round or oval opacities inside the pulp. Pulp stones exist in a wide range of sizes and forms, but they are easy to recognize.[13]

Pulp stones commonly form around the central nidus of the pulp tissue. Calcification begins in a concentric or radial pattern around a central nidus and spreads outwards in a regular calcified material pattern. The process of pulp stone formation is described in **Figure 1**. It has been shown that the remains of Hertwig's epithelial root sheath may induce pulp stone formation.[14]

Figure 1: Formation of pulp stones



Despite intensive morphological research, the origin of pulp stones remains unknown, and nothing is known about their chemical makeup. The organic matrix of pulpal calcifications is made up of reticular connective tissue fibers and a ground substance containing glycoproteins and acid polysaccharides, according to a histochemical investigation.[15] A study suggested that apatite-forming nanobacteria are linked to dental pulp stones.[16]

Etiology

- Some of the etiologic factors that can lead to pulp stone formation are -
- Degenerative changes in pulp
- Epithelial and pulp tissue interactions[14]
- Age[18]
- Variation in the blood supply of pulp[19]
- Orthodontic tooth movement[20]
- Unknown factors[21]
- Genetic predisposition[22]

Rubach & Mitchell concluded that periodontal disease which is not associated with bone loss is a possible causative factor for pulp stone formation.[23] Sayegh & Reed conducted a study on 591 subjects and concluded that calcifications were found more in carious teeth than non-carious.[24] Based on serial sections of 470 teeth, Sundell et al. found a significant co-relation between pulp stone formation and class V restorative procedures.[25] Holtgrave et al. conducted a light microscope-based study in evaluating the role of fluoride prophylaxis in pulp stone formation and the results were statistically significant.[26]

The researchers discovered a link between pulp stone and cardiovascular disease and other systemic disorders. Patients with hypertension, diabetes and gastritis had a higher prevalence of pulp

stones, according to a study.[27] This suggests that the presence of a pulp stone in the pulp tissue of asymptomatic vital pulps can aid in the diagnosis of a serious underlying disease or condition. As a result, more research into the link between pulp stones and systemic disorders is needed.[10]

INCIDENCE RECORDED IN GENERAL POPULATION

There are also differences in the prevalence of pulp stone among different populations as shown in **Table 2**.[10, 28-34]

The disparity across groups could be attributed to geographical factors along with ethnic variances among people. Depending on the study type, design, and radiographic technique employed, The prevalence of pulp stone varies from 8% to 90 %.35

Table 2: Various studies show the prevalence

STUDY	Method of evaluation	Age group	Teeth evaluated	Incidence
Baghdady et al (1988)[28]	Bitewing radiograph	12-13 years	6228	19.12% (Iraqi Population)
Hamasha and Darwazeh (1998)[29]	Bitewing and periapical radiographs	18 or more	4573	22.4% (Jordanian population)
Ranjitkar et al(2002)[30]	Bitewing radiograph	17-35 years	3296	10.1% (Australian population)
Gulsahi et al (2009)[31]	Full mouth periapical radiographs	18-54 years	13747	5%(Turkish dental population)
Talla et al (2014)[10]	Diagnostic IOPA	10-60 years	4449	25.95% (Andhra Pradesh population)
Bains et al (2014)[32]	Bitewing radiograph	18-67 years	500	41.8% (North Indian population)
Turkal et al (2013)[33]	Panoramic radiograph	15 or more	6912	12.7% (Turkish population)
Kannan et al(2014)[34]	IOPA	10-70 years	1779	44.9% (Malaysian population)

PULP STONE FORMATION AFTER ORTHODONTIC TREATMENT

A complex series of tissue reactions occur during orthodontic tooth movement that has an effect on the alveolar bone along with other related supporting structures as well as also involves dental pulp in a manner identical to stimulation caused by chemical or surgical management approaches. Literature reveals that the force application during orthodontic treatment may affect dental pulp-like obliteration of pulpal tissue by the formation of secondary dentin, alteration in pulpal respiration rate, internal root resorption, pulpal necrosis, cyst formation, as well as pulpal calcifications.

The therapeutic element is more important since they can make access to the root canals difficult, if not impossible, during endodontic therapy, and they can also lead to the unjustifiable extraction of a tooth.[36]

Despite the popular belief that pulp stones have no clinical significance, they might cause issues when root canal therapy is required. Their great size in the pulp chamber can obstruct access to canal orifices and change the internal anatomy, and connected stones can create hindrances to engaging the tip of exploring devices, making it difficult for them to go down the canal.[37]

Although there is a lot of literature on pulp stones from an endodontic standpoint, there has not been much research on the association between pulp stone production and orthodontic treatment. This current review provides a comprehensive overview of the subject. Only a few authors have looked into the formation of pulp stones during orthodontic treatment.

According to the literature, pulp tissue obliteration is caused by secondary dentin formation, changes in cyst formation, internal root resorption, pulpal necrosis, pulpal respiratory rate and pulpal calcifications caused by force application during orthodontic treatment can all have an impact on the pulp.[38]

Previous histological studies on the relationship between orthodontic pressures and pulp stones yielded mixed results. Orthodontic stresses, according to a study by Stenvik and Mjör, can cause pulp stone development.[39] According to Ramazanzadeh et al., there is no link between pulp stone formation and orthodontic forces. The authors investigated the effects of orthodontic extrusive and intrusive forces on histological alterations in the human tooth pulp, concluding that there were no significant variations in pulp stone formation following force application between the extrusive, intrusive, and control groups. The type of orthodontic tooth movement was ignored in this investigation.[40]

As shown in **Table 3**, a study conducted by Ertas et al evaluated the incidence of pulp stone formation in a patient who underwent orthodontic treatment. The authors observed a 2.2% rise in the occurrence of pulp stones post orthodontic therapy. They also concluded that the incidence rates were higher in the maxilla than mandible and maxillary 1st molars were the most affected.[38]

Table 3: Incidence of pulp stone before and after treatment

Author	Method of evaluation	Age group	Number of teeth evaluated	Number of pulp stones before treatment	Number of pulp stones after treatment	P-value
Ertas et al (2017)[38]	Panoramic radiograph	12-22 years	16852	257	437	significant
Debkant Jena et al (2018)[41]	Panoramic radiograh	14-26years	3200	165	203	significant
Sarang et al (2018)[42]	Panoramic radiograph	-	500	380	410	Non significant

In 2018, Debkant Jena et al studied the incidence of pulp stone after orthodontic therapy in the south Indian population. They found a significant increase in pulp stones post-treatment. Also

maxillary 1st molar had the highest incidence rate.[41] Another study conducted by Sarang et al concluded that a non significant rise was observed in the prevalence of pulp stones post orthodontic treatment.[42]

Korkmaz et al performed a retrospective study that showed a hike in pulp stones after orthodontic treatment. They concluded that orthodontic forces might alter the calcification process leading to the formation of these calcified masses.[43] Lazzaretti DN assessed the effect of intrusive forces on the dental pulp tissue. Their results showed increased calcification and fibrosis in the pulpal tissue which was attributed to altered vascular supply.[44]

Ranjitkar S et al reported the occurrence of 0.4% pulp stones in premolars and of 19.7% in molars, which was significantly high. Also, the occurrence was higher in maxillary 1st molars as compared to maxillary 1st molars and maxillary or mandibular 2nd molars. This is because molars have a better blood supply, which could result in calcification. Differences in blood supply due to anatomical differences could also be a factor leading to more calcification in molars than premolars.[30] According to Sisman Y et al., molars are the anchoring teeth in the dentition and have a higher blood supply to the pulpal tissue, which may contribute to more calcification.[45]

Conclusion: The following are the conclusions that can be drawn from this review article: Pulp stones can complicate endodontic therapy.

Based on the studies, Orthodontic treatment might lead to pulp stone formation. This is attributed to the fact that orthodontic forces might alter the blood supply and vascular pressure leading to calcifications.

As a result, dentists should be more aware of the existence of pulp stones during endodontic procedures in patients who have had orthodontic treatment. However, additional research is needed to completely understand the function of the orthodontic force in the creation of pulp stones so that appropriate precautions can be taken during orthodontic treatment to prevent them.

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