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Review Article

Pulp stones and its relation with co-morbid diseases

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ABSTRACT

Pulp stones are nodular, calcified masses that can develop in the pulp of healthy, damaged or even developing teeth. In addition to a number of other factors and idiopathic factors, a number of theories have been put forward about the etiological factors behind the occurrence of pulp stones. These include age, genetic susceptibility, pulp degeneration, pulp circulatory disturbances, inductive interactions between pulp tissue and epithelium, and orthodontic tooth movements. Recently, pulp stones development has been linked to a number of systemic disorders, including diabetes, renal diseases, autoimmune diseases, and coronary artery disease. Osteopontin appears to contribute to plaque calcification and is a component of atheromatous plaques. Calcifications have also been noted in renal and carotid arteries with osteopontin, and numerous studies have shown a relationship between atheromatous plaques in arteries and the development of pulp stones. The development of pulp stones, kidney stones, joint calcification, and atheromatous plaques in arteries are thought to share the same mechanism of apatite formation. It has been hypothesized that the biological apatite that nanobacteria produce on their cell walls, which is comparable to kidney stones and calcified tissue, may be a common cause of both pulp stones and atheromatous plaques seen in coronary artery disease. As per the findings of several studies, pulp stones are more severe in coronary artery disease patients. The purpose of this research is to review the available information about pulp stones and its relation with co-morbid diseases.

Keywords: Pulp, Stone, Systemic, Disease

INTRODUCTION

A calcified mass that develops inside healthy or diseased teeth is termed as a pulp stone. It might show up in the pulp's coronal or root region either freely, adherently, or entrenched in the dentin. The stones vary in size, and those smaller than 200 microns cannot be seen using standard radiography techniques. Age, improper blood flow to the pulp, a person's genetic make-up, and prolonged stimuli like tooth decay or deep dental fillings have all been linked

to development of the pulp stones. Pulp stone was typically regarded as an aspect of aging, especially in the elderly. But it can also appear during hereditary or systemic diseases. Pulp stone prevalence has been estimated to range between 8% and 90%. Such variances may depend on the way the studies were designed as well as the radiological procedures. The tiny stones don't hurt. Larger ones, though, can hurt.[1] Unless they invade any nerve fiber bundles, the pulp stones are typically asymptomatic. pulp stones and pulp calcification can sometimes be linked to idiopathic pain. During root canal therapy, the adhering and embedded pulp stones present significant challenges. If present along the root curvature, they result in severe occlusion during the endodontic treatment. Larger pulp stones can significantly alter the internal anatomy and clog the canal.[2]

Patients with systemic or genetic diseases such as dentin dysplasia and dentinogenesis imperfecta may have pulp calcifications throughout their teeth. Hypercalcaemia, gout, and renal lithiasis are examples of diseases that are secondary to the calcium metabolism and have been identified as predisposing factors for pulpal calcification. It has been stated that the incidence of calcification in young people's carious teeth is five times higher than it is in healthy teeth. The secondary dentin deposition that occurs with aging may result in a smaller pulp chamber. Additionally, it has been discovered that pulpal calcification happens as a result of the inflammatory changes in pulp caused by caries, which is a result of the deposition. It has been established that people with end-stage renal disease frequently have pulpal calcification, and there is a direct association between the severity of the renal disease and the pulp constriction in the premolar and molar teeth of these patients. Atherosclerosis, which has been identified as a substantial cause of death and morbidity, is more likely to develop in these people. An early diagnosis of the calcifications in these patients has been suggested as having the potential to save lives. Additionally, carotid artery calcification and dental pulp narrowing in end-stage renal disease have been documented in earlier investigations.[3]

Recently, pulp stones have been linked to a number of systemic disorders, including diabetes, renal diseases, autoimmune diseases, and coronary artery disease. Renal calculi and pulp stones are significantly associated, according to few research studies. Additionally, as per various study findings the presence of pulp stones can serve as a diagnostic sign for systemic disease. Majority of studies present in literature have discussed the association between pulp stones and cardiovascular disease. Recently, relation between pulp stones and hypertension have also been established.[4] Dental pulp cells have the ability to react to local and systemic stimuli by activating osteopontin, forming pulp calcifications, obstructing root canals, and changing internal anatomy. In people with diabetes mellitus, these responses are exacerbated by the dental pulp cells' ability to do these things. Due to the elevated blood glucose levels that activate osteopontin in people with diabetes mellitus, it has been observed that these patients are more likely to develop calcifications.[5] The purpose of this research is to review the available information about pulp stones and its relation with co-morbid diseases.

METHODS

This study is based on a comprehensive literature search conducted on 27 December 2022, in the Medline and Cochrane databases, utilizing the medical topic headings (MeSH) and a combination of all available related terms, according to the database. To prevent missing any possible research, a manual search for publications was conducted through Google Scholar, using the reference lists of the previously listed papers as a starting point. We looked for valuable information in papers that discussed the information about pulp stones and its relation with co-morbid diseases. There were no restrictions on date, language, participant age, or type of publication.

DISCUSSION

Numerous studies have also revealed a relationship between atheromatous plaques in the arteries and pulp stone development. Additionally, there is evidence that gout, renal lithiasis, and hypercalcemia are risk factors for pulp calcifications. It is speculated that the mechanism of apatite formation, which is also referred as pathological biomineralization, causes the formation of dental pulp stones, is similar to joint calcifications and kidney stones, which are considered to be regressive changes in tissues that occur with aging. Dental pulp stone formation is caused by nanobacteria known to produce biological apatite on their cell envelope, as well as kidney stones and other calcified tissues. This raises the possibility that there is a link between the calcifications present in aging or traumatized pulp tissues and the atheromatous plaques present in ischemic heart disease. In addition, osteopontin, a component of the atherosclerotic plaque, appears to be involved in plaque calcification, as it is produced by macrophages, which are key to the initiation of calcific changes seen in other necrotic tissues of the body as part of regressive calcium-attracting dystrophic changes including renal and carotid calcifications.[6]

Evidence from literature

Patil stated that the development of pulp stones has been linked to diseases like hypercalcaemia, gout, and renal calcifications that are recognized as a result of the calcium metabolism. Individuals with end-stage renal disease and recipients of organ transplants have frequently been shown to have pulpal calcification, and there is a positive link between the severity of the renal disease and pulpal obliteration in the premolar and molar teeth of these patients. According to numerous studies, pulp stones are a symptom of systemic diseases that cause abnormal biomineralization in a variety of body organs. However, according to some research studies there is no association

between the calcifications in the pulp and other calcifications in other regions of the body, they also claim that complicated biomechanical and physiological abnormalities seen in systemic disorders do not affect the dentin and pulp.[7] Tarim et al described that nephrolithiasis is more common than ever, with prevalence rates ranging from 2 to 20% worldwide. Kidney stones are linked to worse cardiovascular outcomes and a higher prevalence of chronic illnesses as compared to the general population. According to the literature, pulpal calcification is frequently seen in transplant recipients and individuals with end-stage renal disease. Although, contrary to this there was no statistically significant difference in the prevalence of pulp stones between the study and control groups despite a substantial relation between the chronicity of the renal disease and pulp constriction in our study.[8]

New odontoblasts are generated from dental pulp progenitor cells during tooth injuries including dental caries, trauma, and inflammation, and subsequently dentine will be reformed. Diabetes, a class of metabolic disorders defined by unusually high blood glucose levels or hyperglycemia, has been shown to have an impact on dental pulp as well. The generation of reactive oxygen species and weakened antioxidant defences spurred on by hyperglycemia can result in a variety of diabetic complications. Numerous research documented changes and issues in diabetic dental pulp. Diabetic people have altered dental pulp structure and its constituent parts, restricted pulp capacity, and altered pulpal vasculature. In diabetic dental pulp, there was a reported rise in inflammatory cell infiltration and inflammatory mediator expression.[9]

Jawahar et al stated that the existence of pulpal calcification and its relationship to hypertension or hyperlipidemia were not addressed in any pertinent literature search results. The nonlaminated sample and the pulp stones have an incredibly good fine connection. Vascular calcification may be primarily caused by arterial rigidity, which is connected to hypertension. No matter the patient's age, hypertension causes changes in the production of elastin fragments, increased protease activity, and activation of transforming growth factor-signals in addition to the deposition of collagen and proteoglycans, which creates the ideal environment for vascular calcification. Therefore, it is assumed that similar calcifications can happen elsewhere in the body, including the pulp, causing pulp stones to develop.[10] Studies demonstrate that patients with coronary artery disease exhibit more severe pulp calcifications. More than half of teeth in early adolescents have localized pulp calcifications that can be seen under a microscope. However, pulp stones that involve the entire dentition are rare and require further analysis to determine the likelihood of other associated disorders. Patients with coronary artery disease have an increased risk of developing pulp stones. A series of clinical and biochemical tests, which have the obvious advantage of detecting changes before clinical disease manifests itself and its signs and symptoms become apparent, may rule out such a person as a candidate for coronary artery disease in the presence of other compounding risk factors.[11] This was further validated by the findings of Edds et al who demonstrated that just 39% of patients without a history of cardiovascular disease developed pulp stones, compared to 74% of people with a history of the condition.[12]

Almutlaq et al reported a notable correlation between pulp stones and advanced age. Patients with systemic diseases are far more likely to get pulp stones, especially those who have heart disease or diabetes as revealed in the findings, cardiovascular diseases and diabetes mellitus were substantially linked with 86.25% of pulp stones. Inferentially, 87.79% of individuals between the ages of 46 and 60 were predisposed to pulp stone development. Between male and female patients, there was a considerable variation in the formation of pulp stones.[13] Findings of a comparative study revealed that of the 1432 teeth examined, 134 had pulp stones. Significantly more pulp stones than other groups were seen in patients with cardiovascular disorders (15.86%). Pulp stones were more common in molars (18.29%) compared to premolars (6.6%) and in the maxillary arch (12.36%) compared to the mandibular arch (5.95%). There was no discernible difference between the genders and the sides. The relation between pulp stones and systemic disease is positive.[14] Similarly, Madhoon et al concluded that compared to younger patients pulp stones were related to cardiovascular diseases in patients over the age of 40.[15]

Results of a study by Khojastepour et al showed that out of 122 patients who met the criteria, 68.2% of the patients with cardiovascular diseases exhibited pulp chamber calcifications, demonstrating that patients with cardiovascular diseases have a higher frequency of pulp calcification than healthy patients. The ability to predict cardiovascular disease using panoramic radiography was 68.9% sensitive. The authors further suggest that pulp calcification on panoramic radiography might be useful for screening for cardiovascular diseases.[16] However contradictory to this Alsweed et al revealed that on panoramic radiographs, the incidence of pulp stones was 4.6%, whereas the prevalence of carotid artery calcifications was 2.0% ($p=0.714$). There was no statistically significant association between pulp stones and carotid artery calcifications. Carotid artery calcifications were statistically more common in older patients than in younger patients ($p<0.001$), and pulp stones were statistically more common in younger patients than in older patients ($p=0.001$). In terms of the prevalence of either carotid artery calcifications or pulp stones, there were no appreciable differences between males and females ($p=0.087$ and $p=0.278$, respectively). To rule out the occurrence of carotid artery calcifications, dentists should be educated to evaluate for them on panoramic radiographs belonging to patients over 40. Additionally, pulp stones are not a reliable diagnostic indicator of carotid artery calcifications.[17] Studies discussing the relation of pulp stones and comorbid diseases show contrasting results

additionally, are quite scarce and limited hence advocating the need of further research to elaborately study the association and describe the mechanism behind relationship of pulp stones and comorbid diseases.

CONCLUSION

Studies present in literature describe that pulpal calcification and systemic diseases such as type II diabetes, cardiovascular disease, and renal disease are positively correlated however further research is direly needed to generate evidence-based results to validate the association between them.

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