

The offices of Dr. Steven Singh

HILLSBORO OFFICE

434 S. First Avenue
Hillsboro, OR 97123
(503) 693-6163

WASHINGTON SQUARE

9735 SW Shady Lane, Suite 308
Portland, OR 97223
(503) 693-6163

www.westsideendo.com



Pulp Stones and Cardiovascular Disease

As a function of the normal calcification of bodily tissues, calcium deposits occur in the bones and teeth. However, 2 categories of abnormal calcification, called “stones,” may occur.

- **Metastatic calcification**, typically the result of an imbalance in calcium metabolism, that may lead to stones in blood vessels, kidneys and joints.
- **Dystrophic calcification**, which occurs in necrotic or nonviable tissue, typically forms in dental pulp.

Pulp stones may appear on radiographs as lesions or plaque and are usually asymptomatic, the result of pulpal tissue self-repair in response to a long-lasting irritation. Although several explanations for the etiology of pulp stones have been proposed, including the aging process, the presence of nanobacteria, heredity and higher concentrations of calcium and phosphate in the blood, their pathogenesis remains unknown.

Some studies have suggested an association between coronary artery stenosis, directly associated with ischemic heart disease, and pulp stones, while

other studies have suggested an association between renal stones and other calcifications. In order to gain clarity, Almadhoon et al from Al-Azhar University, Palestine, undertook a systematic review and meta-analysis of the available evidence to determine the associations between pulp stones and cardiovascular disease and/or renal stones.

The authors searched for retrospective and prospective studies of patients with cardiovascular disease or renal stones and radiographic confirmation of pulpal stones. Nineteen studies, with a total of 4735 participants, met the authors' inclusion criteria; 13 studies involved patients with cardiovascular disease, 5 studies reviewed renal stones, and 1 study addressed both cardiovascular disease and renal stones.

The meta-analysis showed a significant relationship between pulp stones and cardiovascular disease in general; the relationship between pulp stones and specifically coronary artery stenosis remained significant, but not between pulp stones and carotid artery stenosis. In the 3 studies that looked at the ages of patients with pulp stones, those

Inside this issue:

- **Comparative Outcomes With Glass Fiber and Cast Metal Posts**
- **Impact of Access Preparation on Molar Life Span**
- **Prevalence of Middle Mesial Canals**

who were >40 years old exhibited a prevalence of cardiovascular disease 2× greater than did younger patients, while no significant difference was seen when patients were grouped by sex. No relationship could be established between pulp and renal stones in general or when stratified by sex.

Conclusion

The currently held clinical view is that pulp stones do not have clinical significance, except as a possible complication to endodontic treatment at which time they can block access to root canal orifices and hinder proper cleaning and shaping procedures. While a study such as this meta-analysis can show an association between pulp stones and cardiovascular disease, it cannot establish a direct relationship between the 2 conditions. Nevertheless, the suggestive association between pulp stones and cardiovascular disease in patients >40 years of age may guide the dentist's recommendations in a holistic view of patient health.

Almadhoon HW, AlKafarna M, Asla MM, et al. The association of dental pulp stones to cardiovascular and renal diseases: a systematic review and meta-analysis. *J Endod* 2022;48: 845-854.

Comparative Outcomes with Glass Fiber and Cast Metal Posts

When not enough dentin remains to support retention of the coronal restoration following endodontic treatment, the employment of a glass fiber or cast metal post, in addition to retain-

ing the coronal restoration, may help prevent root canal cracking and fracturing. Glass fiber posts provide good esthetic and functional results; cast metal posts demonstrate suitable mechanical properties when undergoing excessive loading.

However, little consensus exists about which type of post is preferable and the impact of post type on treatment success. To address this question, da Luz-Silva et al from the Federal University of Pelotas, Brazil, designed a prospective study to determine the impact of post type on the onset, progression and remission of periapical lesions in endodontically treated teeth.

Their study enrolled 92 patients treated at a university clinic between 2009 and 2017 who had received glass fiber or cast metal posts as part of their endodontic treatment. Teeth included in the study were free of caries and periodontal disease, had bilateral posterior occlusal contact, and were in need of intraradicular retention. Teeth with a periapical lesion underwent endodontic as did teeth with inadequate endodontic fillings. Posterior and anterior teeth in the mandible and maxilla were included. After completion of endodontic procedures, the treated teeth received either a glass fiber post cleaned with ethyl alcohol and pretreated with silane or a cast metal post manufactured using acrylic resin.

A periapical radiograph was taken of each tooth after placement of the post; this was considered the baseline for future comparisons. All teeth received a conventionally manufactured metal-ceramic or direct composite restoration. Patients were followed for ≥1 year, during which time the teeth were assessed both clinically

and radiographically, and scored for periapical status using the Periapical Index Score (PAI). The apical areas of the radiographic images were rated as

- **PAI score 1:** normal periapical structures
- **PAI score 2:** presence of small changes in bone structure
- **PAI score 3:** changes in bone structure with some mineral loss
- **PAI score 4:** periodontitis with well-defined radiolucent area
- **PAI score 5:** severe periodontitis with exacerbating features

Teeth with PAI scores of 1 and 2 were classified as successes. Teeth with PAI scores ≥3 at first evaluation underwent endodontic retreatment; those with PAI scores ≥3 at later evaluations were considered failures.

After a mean follow-up of 5.1 years, data were available for 140 restorations in 92 patients. Approximately two-thirds of the teeth received glass fiber posts. Of the 13 failures reported, 5 were in the cast metal post group and 8 in the glass fiber post group. Four failures occurred in teeth with PAI scores of ≥3 at baseline and were considered endodontic failures. The remaining 9 were considered restorative failures; 5 were from the glass fiber post group and 4 from the cast metal post group. Overall success rate was 97%, with no significant difference between the groups (Table 1).

Conclusion

This study's results may be limited by the exclusion of patients with parafunctional habits and the lack of a randomization protocol. Nevertheless, the type of post used with a full crown restoration did not influence the outcome of endodontic treatment. Rather, accord-

Table 1. Endodontic outcomes at final follow-up.

| | Glass fiber post (n = 94) | | Cast metal post (n = 46) | |
|-------------------|---------------------------|---------|--------------------------|---------|
| | PAI 1–2 | PAI 3–5 | PAI 1–2 | PAI 3–5 |
| Initial PAI score | 78.7% | 21.3% | 65.2% | 34.8% |
| Final PAI score | 96.8% | 3.2% | 97.8% | 2.2% |

p = 0.7 for final PAI scores.

ing to the authors, “Precautions taken during endodontic therapy, post cementation, and final restoration will be responsible for sealing the root canal of the intraoral cavity and are essential to the success of endodontic treatment.”

da Luz-Silva G, Vetromilla BM, Pereira-Cenci T. Influence of post type on periapical status: a prospective study in a Brazilian population. Clin Oral Investig 2022;26:781-787.

Impact of Access Preparation on Molar Life Span

Rather than employing the traditional straight-line access method, a growing trend in endodontics has been the adoption of access cavity designs that preserve as much dentin as possible. Several studies focused on the shift from the convenience of straight-line access to the primary goal of tissue preservation, even if that requires providing a curved trajectory to gain access to root canal orifices. Recent publications have shown that by preserving the dental soffit, conservative access cavities provide better tooth integrity.

Nawar et al from the British University in Egypt conducted a finite element analysis to isolate and evaluate the effect of access cavity preparation and coronal canal flaring to determine the

significance of the radicular part of pericervical dentin.

The researchers used an intact, sound, mature human maxillary first molar to create a 3-dimensional mathematical model, which was then validated and tested using a universal testing machine to apply load and measure displacement. Once the intact tooth model was validated, a model with a conservative access design was created using a line drawn from the center of the root canal orifice at the furcation level and extended to the occlusal surface. The access cavity was then filled with simulated composite resin materials. Three additional models were created for shaped models. Palatal canals were shaped to size #40/.04 taper, buccal canals to size #25/.04 taper. The coronal 4 mm was shaped in each of these models to match the size of 1 of 3 coronal canal flaring instruments:

- **ProTaper Gold SX** (Dentsply Sirona, Ballaigues, Switzerland)
- **OneFlare** (Micro-Mega, Besançon, France)
- **Gates-Glidden size 4** (Premier Dental Co., Norristown, PA).

The prepared root canals were filled with simulated gutta-percha filling materials. All 5 models were then subjected to cyclic occlusal loading to determine their estimated lifespan.

Stresses on all treated teeth went farther apically on the palatal root than they did on the intact tooth. Initial

failure occurred in all treated teeth at the point of maximum stress, at the midpoint of the occlusal-palatal line angle along the lingual groove between the palatal cusps. The conservative access model suffered a 6% loss of tooth life compared with the intact model. All 3 models with coronal canal flaring performed similarly to the conservative access model; no significant differences were seen among teeth treated using the 3 different coronal canal flaring instruments.

Conclusion

This study showed that the only significant reduction in a tooth's lifespan was related to the coronal removal of enamel and dentin during the access cavity preparation, while the choice of instruments used for canal shaping had no additional effect on tooth survival. Further research needs to be conducted to compare the impact of treatment that avoids the use of straight-line access.

Nawar NN, Kataia M, Omar N, et al. Biomechanical behavior and life span of maxillary molar according to the access preparation and pericervical dentin presentation: finite element analysis. J Endod 2022;48:902-908.

Prevalence of Middle Mesial Canals

Mandibular first molars are among the most frequent teeth to undergo endodontic treatment, yet they are also among the most challenging. Cleaning and shaping the root canal system can be difficult due to the system's potential complexity and variation, including

the presence of extra roots, isthmuses between root canals, C-shaped configurations and accessory canals. The middle mesial canal, an accessory canal in the mesial root between the mesio-buccal and mesiolingual root canals, is hard to detect and difficult to gain access to given its location deep within the developmental groove or isthmus joining the 2 major root canals.

Previous analysis has categorized middle mesial canals into 3 types:

- **The fin type** lacks a separate orifice, but an endodontic file can move freely between the mesiobuccal or mesiolingual canal and the middle mesial canal.
- **The confluent type** has a separate orifice but joins the mesiobuccal or mesiolingual canal apically.
- **The independent type** has a separate orifice and apical foramen.

Because failure to identify an extra canal is one of the most common causes of endodontic treatment failure, understanding the prevalence and morphological variations of the middle mesial canal may be critical to successful endodontic treatment.

Few previous studies have reported either the frequency of middle mesial canals in mandibular first molars, the prevalence of each variation or their association with anatomical features. Bhatti et al from Riphah International University, Pakistan, analyzed cone-beam computed tomography (CBCT) scans of 298 first mandibular molars (149 patients) for the presence of middle mesial canals, along with 298 second mandibular molars for the presence of C-shaped canals.

The researchers identified middle mesial canals in 23 mandibular first molars, including 5 fin, 10 confluent

Table 2. Frequency of middle mesial canals.

| | Right mandibular molars | Left mandibular molars | Men | Women |
|----------------------------|-------------------------|------------------------|-------------------|-------------------|
| Middle mesial canal | | | | |
| Present | 10 (6.7%) | 13 (8.7%) | 14 (9.4%) | 8 (11.2%) |
| Absent | 139 (93.2%) | 136 (91.2%) | 64 (82.0%) | 63 (88.7%) |
| Total | 149 | 149 | 78 (52.3%) | 71 (47.7%) |

and 8 independent types. Six of the confluent and 3 of the fin types were located close to the buccal orifice; 4 of the confluent and 2 of the fin types were located close to the lingual orifice. One independent type ended blindly in the middle third of the root.

No statistically significant differences were seen between male and female patients or between left and right mandibular molars (Table 2). Additional findings included the presence of an isthmus in 64 molars, while 34 of the examined mandibular first molars were adjacent to a second molar with a C-shaped canal configuration.

These first molars adjacent to second molars with a C-shaped configuration were 3× more likely, and those with an isthmus were 2× more likely, to have a middle mesial canal. Although mean inter-orifice distance in general did not significantly affect the likelihood of a middle mesial canal, teeth with an inter-orifice distance of >2.95 mm were significantly more likely to have a middle mesial canal.

Conclusion

The frequency of middle mesial canals found in this study was within the range of that reported in previous, similar studies; differences could be attributed to the use of CBCT to identify middle mesial canals and/or the age and ethnicity of the patient group. While this study identified the confluent type as the most frequent,

other studies have shown inconsistent results, and determining the correct answer may require a systematic review of the literature to create a large-enough sample size. While the presence of a middle mesial canal is not common, its potential to cause endodontic treatment failure if overlooked emphasizes the need for the practitioner to carefully explore the region between the mesiobuccal and mesiolingual canals in first mandibular molars.

Bhatti UA, Muhammad M, Javed MQ, Sajid M. Frequency of middle mesial canal in mandibular first molars and its association with various anatomic variables. Aust Endod J 2022;48:494-500.

In the next issue:

- Effect of analgesics on pulpal sensibility tests
- Prevalence of maxillary sinusitis of odontogenic origin
- Inflammatory status of the dental pulp

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