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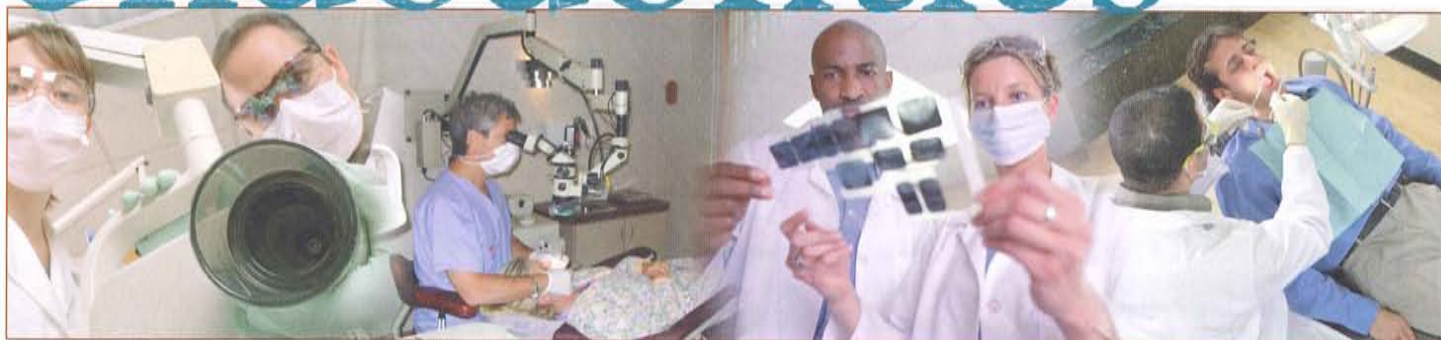
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Smoking, Hypertension and Endodontic Variables

Moderate elevation of arterial blood pressure (BP) leads to shortened life expectancy, and persistent hypertension (HTN) is one of the risk factors for coronary heart disease, stroke, heart failure and arterial aneurysm. The relationship between high BP and more severe periodontal parameters has been well established. Studies have found that patients with HTN show a poorer periodontal state.

Periodontal disease and chronic apical periodontitis (AP) share a common gram-negative anaerobic microbiota, and both are associated with elevated levels of cytokines and inflammatory mediators. Studies analyzing a possible association between HTN and endodontic variables have

found that HTN contributes to decreased retention of root-filled teeth, but it is not significantly associated with a dental periapical condition. Epidemiologic studies have found a relationship between tobacco smoking, AP and the outcome of root canal treatment.

To investigate the relationship between smoking and the prevalence of AP and root canal treatment in hypertensive patients, Segura-Egea from the University of Sevilla, Spain, conducted a cross-sectional study of 100 patients with well-controlled HTN (diastolic BP ≤ 90 mm Hg). Among the patients, 50 were smokers (mean age, 60.0 ± 9.6 years) and 50 were nonsmokers (mean age, 58.3 ± 9.6 years). Patients < 18 years of age and patients with < 8 remaining teeth were excluded. The total sample consisted of 53 men and 47 women, aged 58.7 ± 9.6 years.

Smoking history was obtained by interviewer-administered questionnaires. Hypertensive patients were classified as nonsmokers if they answered "no" to the question "Have you ever smoked?" Patients who answered "yes" to the question were classified as smokers.

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Full-mouth radiographic surveys revealed 46 smoker patients (92%) and 22 nonsmoker patients (44%) with AP in ≥ 1 teeth (Table 1). The average number of teeth with AP per patient was 1.3 ± 0.7 among the smokers and 0.4 ± 0.5 among the nonsmokers, a significant difference ($p < .01$). One or more root-filled teeth were found in 58% and 20% of smoker and nonsmoker patients, respectively. Multivariate logistic regressions with age, number of teeth and smoking habits as independent variables, and periapical status as the dependent variable found that smoking was associated with an increased risk for periapical lesions.

Conclusion

The authors concluded that the prevalences of AP and root canal treatment are significantly higher in smoker hypertensive patients compared with nonsmoker patients, suggesting a relationship between smoking and these 2 endodontic variables. However, this study has limitations, including the fact that a prevalence of diabetes, a confounding factor that could affect the incidence of AP and HTN, was not recorded.

Segura-Egea JJ, Castellanos-Cosano L, Velasco-Ortega E, et al. Relationship between smoking and endodontic variables in hypertensive patients. *J Endod* 2011;37:764-767.

Effectiveness of Irrigants Against Endodontic Infection

Because endodontic infection plays an essential role in causing pulpal and periapical disease, the main objective of endodontic therapy of teeth with periapical lesions is to eliminate infection within the root canal system. Instrumentation and irrigation have been unable to eliminate infection, sometimes resulting in a failure of endodontic treatment.

Sodium hypochlorite (NaOCl) is widely used as an irrigating solution because of its antimicrobial activity, tissue-dissolving property, detergent action and ability to neutralize toxic products. However, the efficacy of NaOCl is affected by its concentration, temperature and pH. Apple vinegar, containing mainly acetic acid and malic acid, can lower the pH of NaOCl, has the ability to remove the smear layer and is active against endodontic microorganisms. As such, it can be considered an alternative for use in combination with NaOCl.

To evaluate the pH and available chlorine content in 2.5% NaOCl

solutions, pure and in combination with 10% citric acid or apple vinegar in different ratios, Guerreiro-Tanomaru et al from Universidade Estadual Paulista, Brazil, conducted an in vitro study of the antibacterial action of these substances and their combinations. The pH and the chlorine content of 2.5% NaOCl solution were measured pure and in combination with 10% citric acid or apple vinegar in the following ratios (by volume): 8:2, 7:3, 6:4, 5:5, 4:6, 3:7 and 2:8. All analyses were conducted in triplicate.

The combination of 2.5% NaOCl with 10% citric acid lowered both the pH of the NaOCl and the available chlorine content. The higher the amount of acid in the solution, the lower the values found for pH and chlorine availability. A similar effect was observed for the combination of 2.5% NaOCl with apple vinegar.

Microbiological assays were performed in a laminar flow chamber. The following solutions and combinations were investigated: 2.5% NaOCl, 2.5% NaOCl + 10% citric acid at 7:3 ratio, 2.5% NaOCl + apple vinegar at 5:5 ratio, 10% citric acid and apple vinegar. Sterile saline was used as a negative control. A direct contact method was used, and all experiments were conducted in triplicate.

Plain 2.5% NaOCl solution, as well as in combination with 10% citric acid or apple vinegar, fully eliminated *Enterococcus faecalis* within 30 seconds of contact. Plain 10% citric acid eliminated *E faecalis* in 10 minutes. Apple vinegar promoted a reduction in the number of viable cells by 32% at the end of the experiment.

Table 1. Prevalence of AP, root-filled teeth and root-filled teeth with AP among hypertensive patients

	AP	Root-filled teeth	Root-filled teeth with AP
Smokers	46 (92)	29 (58)	20 (70.0)
Nonsmokers	22 (44)	10 (20)	9 (90.0)
Total	68 (68)	39 (39)	29 (74.4)
Odds ratio, smokers	14.6*	5.5*	0.25†

All data except odds ratios are n (%). * $p < .01$; † $p > .05$.

Conclusion

Considering the methodology used and the results obtained, this study concludes that the combination of 2.5% NaOCl with 10% citric acid or apple vinegar lowered the pH and the chlorine content but did not affect the antibacterial activity, compared with pure NaOCl solution. Plain citric acid and apple vinegar showed weak activity against *E faecalis*. Additional studies are needed to clarify the physical and chemical interactions between NaOCl and different acids.

Guerreiro-Tanomaru JM, Morgental RD, Flumignan DL, et al. Evaluation of pH, available chlorine content, and antibacterial activity of endodontic irrigants and their combinations against Enterococcus faecalis. Oral Surg Oral Med Oral Pathol Oral Radiol Endod 2011;112:132-135.

Factors Affecting Survival Outcomes Of Endodontically Treated Teeth

To determine the efficacy of primary or secondary root canal treatments, previous studies have used periapical healing and tooth survival to measure outcomes, but differences in study design have often made effective direct comparison of the findings difficult. Ng et al from University College London, United Kingdom, conducted a prospective study to investigate the probability of and factors that influence tooth survival following initial root canal treatment (1°RCTx) and endodontic retreatment (2°RCTx).

Table 2. Preoperative factors adjusted for type of treatment

Factors	Adjusted HR (95% CI)
Pain	2.21 (1.34–3.62)
Sinus	2.60 (1.54–4.40)
Probing depth ≥5 mm	2.39 (0.95–6.03)
Coronal perforation	2.37 (0.85–6.59)

HR, hazard ratio; CI, confidence interval.

The study involved annual follow-up for up to 4 years of 1°RCTx and 2°RCTx performed on patients who had been treated in the hospital's endodontic department from October 1997 through June 2005. All patients were >15 years old when treatment began and had had either 1°RCTx or 2°RCTx and at least a semipermanent restoration in place. Reasons for exclusion included preoperative periodontal disease, prior endodontic treatment or the fact that the apex/apices being investigated were not obvious on periapical radiographs. Pre-, intra- and postoperative data were collected via predesigned forms.

In total, 759 of 924 teeth undergoing 1°RCTx and 858 of 1113 teeth undergoing 2°RCTx fulfilled the inclusion criteria and were available for survival analysis. By the end of the study period, 724 (95.4%) teeth undergoing 1°RCTx and 817 (95.2%) of patients undergoing 2°RCTx were still functionally available at the follow-up review.

The involved tooth was rated as "survived" if it was still present and potentially functional at follow-up, regardless of clinical or radiographic findings. It was considered as "failed

to survive" if the tooth had been extracted after treatment. Cox proportional hazards regression models investigated factors affecting the survival of the teeth after either root canal treatment (Table 2).

Four significant preoperative prognostic factors were identified:

- Preoperative periodontal probing depths >5 mm were associated with 2× more tooth loss.
- The presence of preoperative pain had a profound effect on tooth loss within the first 22 months after treatment, with a lesser effect >22 months after treatment.
- The presence of a preoperative sinus tract increased the hazard of tooth loss by 120%.
- The presence of pre- or intraoperative perforation increased tooth loss by nearly 300%.

Five significant postoperative restorative factors were identified:

- Teeth restored with temporary restorations were 7–8× more likely to be extracted after treatment than were their counterparts.
- Teeth restored with a cast restoration after treatment reduced tooth loss by approximately 60%.
- Teeth with restorations retained with a cast post-and-core were 2.6× more likely to be extracted.
- Teeth with 2 proximal contacts had 50% lower hazard of tooth loss after treatment than did those teeth with 0 or 1 proximal contact.
- The most posterior teeth were associated with almost 96% more tooth loss than were those not located distal-most in the arch.



Conclusion

The 4-year survival rate of teeth after 1°RCTx or 2°RCTx was high (95%), and there was no difference between the 2 treatments. Tooth survival improved if patients did not suffer from diabetes or receive systemic steroid therapy; preoperative deep periodontal probing defects, pain and sinus tract were absent; pre- and intraoperative tooth perforation did not exist; patency at canal terminus was achieved; root filling extrusion was not present; teeth had cast restoration after treatment; teeth had both mesial and distal adjacent teeth present; and teeth did not require cast post and core for support and retention of restoration.

Ng Y-L, Mann V, Gulabivala K. A prospective study of the factors affecting outcomes of non-surgical root canal treatment: part 2: tooth survival. *Int Endod J* 2011; doi:10.1111/j.1365-2591.2011.01873.x.

Evaluation of Procedures for Surgical Smear Layer Removal

Over the last several years, the techniques and materials used in surgical endodontics have evolved and improved. In fact, outcome studies have shown very high success rates comparable, if not superior, to the success rate of conventional retreatments. Many root canal systems have “inaccessible areas” consisting of isthmi, lateral canals, accessory canals and ramifications within the apical 3 mm that sometimes may not allow for a complete eradication of the infec-

tion with conventional endodontic retreatment.

As a result of the root end resection and retrograde cavity preparation, a smear layer forms on the dentinal surfaces cut by the instruments. This smear layer may contain microorganisms and necrotic pulpal tissues, which may cause persisting periapical inflammation. Some practitioners have advocated the removal of the smear layer from the root canal walls during routine endodontic treatment.

Fabiani, a private practitioner from Italy, et al evaluated 2 different in vitro procedures for the removal of the smear layer in root-end cavities prepared with ultrasonic surgical retreatips. The study included 28 single-rooted teeth extracted for periodontal reasons.

Root canal treatment was performed using conventional methods. After canal obturation, the apical 3 mm of each root were resected with a carbide bur at an angle 90° to the long axis of the tooth. Retrograde cavities were then prepared to a depth of 3 mm, with ultrasonic retreatips using air spray as a cooling aid.

The teeth were divided randomly into 2 groups of 11 teeth each and 1 group of 3 teeth for negative control:

- Retrograde cavities of teeth in group A were treated with a gel of 35% orthophosphoric acid for 15 seconds, followed by 1 minute of rinsing with distilled water.
- Retrograde cavities of teeth in group B were treated with a gel of 24% EDTA at a neutral pH for 2 minutes, followed by 1 minute of rinsing with distilled water.

- Retrograde cavities of teeth in the negative control group did not receive any treatment.

A blind evaluation registered the presence of the smear layer on the surfaces of the canal walls. The data were then analyzed statistically.

In group A, 80% of the samples showed an optimal degree of wall cleanliness, with dentinal tubules completely open. The majority of analyzed samples from group B (64%) showed dentinal tubules covered with the smear layer. All the analyzed samples from the negative control group showed dentinal tubules covered with the smear layer. The statistical analysis showed a statistically significant difference between groups A and B ($p = .0004$).

Conclusion

According to the results of this study, orthophosphoric acid gel was more effective than EDTA in removing surgical smear layer. It is also preferable because its action requires less time.

Fabiani C, Franco V, Covello F, et al. Removal of surgical smear layer. *J Endod* 2011;37:836-838.

In the next issue:

- Irrigation techniques and smear layer removal
- Maintaining apical patency on irrigant penetration
- Viruses and bacteria in acute apical abscesses

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