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Type 2 Diabetes Mellitus and Apical Periodontitis

Many studies have demonstrated an increased incidence of apical periodontitis in patients who suffer from type 2 diabetes mellitus. According to a report issued last year by the Centers for Disease Control and Prevention, >10% of Americans have type 2 diabetes mellitus; thus, this relationship may have a major impact on dental health. However, no researchers had studied this patient group using a sufficiently large U.S. population and controlling for possible confounding variables.

Recently, Yip et al from the University of North Carolina at Chapel Hill published a case-controlled study of >15,000 patients to determine (1) whether apical periodontitis is independently associated with type 2 diabetes mellitus after controlling for confounding variables and (2) whether varying levels of glycated hemoglobin (HbA_{1c}) were associated with apical periodontitis. From the records of 7 dental clinics at hospitals spread throughout North Carolina, the researchers identified 7749 patients with diagnoses of both apical periodontitis and type 2 diabetes mellitus. They then created a control group of the same number of patients from the same hospital clinics, matched by age, race and sex, who did not have a diagnosis of apical periodontitis.

In addition to periodontal and diabetes status, the following variables for each patient were recorded:

- HbA_{1c}
- oral cellulitis
- body mass index (categorized as obese or nonobese)
- primary and secondary hypertension
- atherosclerosis
- chronic kidney disease
- smoking status
- use of metformin (a drug commonly prescribed to treat type 2 diabetes mellitus)
- use of statins (a class of drugs commonly prescribed for hypercholesterolemia)

Several regression models were created to determine whether an association

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exists between periodontal disease and type 2 diabetes mellitus, and what (if any) impact any of the studied variables had on that association.

Nearly twice as many patients with apical periodontitis also had a diagnosis of type 2 diabetes mellitus. This relationship held even after controlling for demographic factors and potential confounding variables. Interestingly, patients taking either statins or metformin had significantly lower odds of developing apical periodontitis (Table 1). Patients with poorly controlled HbA_{1c} levels (defined as HbA_{1c} >8.0) had significantly greater odds of developing apical periodontitis, as did current and former smokers and patients diagnosed with atherosclerosis or hypertension.

Conclusion

While it is impossible for a study like this to establish a direct cause-and-effect relationship between type 2 diabetes mellitus and apical periodontitis, this study's large sample size and strict control of potential confounding variables allowed it to show a strong independent association between the 2 conditions, with higher HbA_{1c} levels significantly associated with apical periodontitis. Patients on metformin therapy, which is frequently prescribed to control HbA_{1c}, were less likely to be afflicted with apical periodontitis.

Yip N, Liu C, Wu D, Fouad AF. The association of apical periodontitis and type 2 diabetes mellitus: a large hospital network cross-sectional case-controlled study. J Am Dent Assoc *2021; 152:434-443.*

Table 1. *Association of apical periodontitis with type 2 diabetes mellitus.*

	Odds ratio
Type 2 diabetes mellitus	2.05
Periodontal disease	27.07
Oral cellulitis	24.16
Hypertension	1.59
Current smoker	3.93
Former smoker	1.40
Atherosclerosis	1.36
Metformin use	0.82
Statin use	0.70

All associations listed are statistically significant.

Vertical Root Fractures After Apical Surgery

One of the most frequent causes of tooth loss is vertical root fracture, which occurs primarily, although not exclusively, in association with root canal treatment. Vertical root fractures tend to develop slowly and often go unnoticed until clinical signs and symptoms occur, by which time extraction may be the only possible treatment. Apical surgery, also known as endodontic microsurgery, has proved to be a successful modality for treating persistent or recurrent endodontic infection, but it may jeopardize the long-term prognosis in teeth that have already undergone endodontic therapy.

To determine the frequency of vertical root fractures in teeth treated with apical surgery, von Arx et al from the University of Bern, Switzerland, conducted a retrospective study of 864 patients who had been treated with apical surgery over a 20-year period. All surgeries had been performed by the same surgeon in a dedicated surgical room, under local anesthesia and using a surgical microscope. Follow-up took place at 1, 5 and 10 years after surgery; all teeth in this study had at minimum a follow-up of 1 year. Vertical root fractures were identified in extracted or surgically removed teeth.

The overall rate of vertical root fracture after apical surgery in these teeth was 4%. Thirty-three percent of the vertical root fractures occurred in mandibular first molars; slightly more than one-quarter occurred in maxillary second premolars. Fractures occurred most frequently in the mesial root of mandibular molars. Vertical root fractures occurred in <1% of treated maxillary anterior teeth; fractures in mandibular premolars were also rare. No significant difference in the incidence of vertical root fracture was found between men and women or between primary and repeated apical surgery. The percentage of vertical root fracture rose as the patient's age increased, but the increase did not achieve statistical significance. Two-thirds of the vertical root fractures occurred within the first year after apical surgery.

Conclusion

Previous studies have shown that maxillary premolars and mandibular molars (especially the mesial root of mandibular first molars) are at the highest risk for vertical root fractures, a conclusion this study supports. Those studies also demonstrated that endodontic retreatment significantly increased the number of cracked and fractured roots. The most important takeaway from this study is its finding that vertical root fractures are infrequent following treatment with apical surgery or resurgery.

Table 2. *Outcomes in endodontically treated molars at 5-year follow-up.*

	Extractions	Nonsurgical retreatment	Endodontic surgery	Overall additional treatments
Maxillary first molars				
1–3 canals filled	11.3%	3.1%	1.5%	15.2%
4 canals filled	8.2%	2.4%	2.6%	12.7%
Maxillary second molars				
1–3 canals filled	12.1%	1.7%	0.3%	13.8%
4 canals filled	7.6%	1.2%	0.2%	9.1%
Mandibular first molars				
1–3 canals filled	10.7%	3.1%	0.6%	14.0%
4 canals filled	8.1%	2.2%	0.6%	10.7%
Mandibular second molars				
1–3 canals filled	13.7%	2.0%	0.1%	15.6%
4 canals filled	12.1%	2.0%	0.2%	13.7%

von Arx T, Maldonado P, Bornstein MM. Occurrence of vertical root fractures after apical surgery: a retrospective analysis. J Endod *2021;47:239-246.*

Five-Year Endodontic Outcomes in Molars

When a patient presents with a tooth requiring endodontic treatment, the desired outcome from the patient's perspective is to retain, for as long as possible, a functional and symptom-free tooth. Because of the number of canal systems in molars, some canals may go untreated. Although these untreated canals are associated with an increased risk of apical periodontitis, that result may not have a major impact on the tooth's long-term survival and functionality. Markvart et al from the University of Copenhagen, Denmark, analyzed 5-year results of root canal treatment in first and second molars to determine the frequency of the need for additional treatment in a large cohort of patients.

Using the Swedish Social Insurance Agency database, the authors identified slightly more than 100,000 individuals who, during 2009, underwent root canal treatment of a first or second molar. They divided the procedures into 2 groups: those in which 4 canals were filled and those in which <4 canals were filled. A much greater proportion of first molars than second molars had 4 canals filled.

The patients' records for the following 5 years were analyzed to determine which treated teeth required additional treatment in 1 of 3 areas:

- extraction
- nonsurgical retreatment of ≥1 canals
- endodontic surgery

These retreatments were chosen because the authors believed them to be the most likely indicators of less-than-optimal primary root canal therapy.

A significantly higher percentage of maxillary first molars with 1 to 3 root-filled canals required additional treatment, compared with those with 4 root-filled canals; the same held true for maxillary second molars and mandibular first molars, but not for mandibular second molars.

Extractions were performed less frequently in mandibular first molars; maxillary molars and mandibular first molars with <4 root-filled canals were extracted more frequently than were similar teeth with 4 root-filled canals. First molars required nonsurgical retreatment more frequently than did second molars; first molars with <4 root-filled canals underwent nonsurgical retreatment more frequently than did those with 4 root-filled canals. However, endodontic surgery was performed more often on maxillary first molars with 4 root-filled canals; in other molars, the number of canals filled had no significant impact on the incidence of endodontic surgery (Table 2).

Conclusion

Maxillary molars and mandibular first molars with 4 root-filled canals were less likely to be extracted or undergo nonsurgical retreatment than were the same teeth with only 1 to 3 root-filled canals. From a clinical standpoint, perhaps the most important outcome of this study was that approximately 85% of molars receiving root canal treatment were functional and symptom-free after 5 years.

Markvart V, Tibbelin N, Pigg M, et al; Endo-ReCo. Frequency of additional treatments in relation to the number of root filled canals in molar teeth in the Swedish adult population. Int Endod J *2021;54:826-833.*

Regenerative Healing in Endodontic Surgery

Ideally, healing after endodontic surgery involves a regenerative process in which cells from the original tissue heal the wound, fully restoring the tooth's architecture and function. However, this result is difficult to achieve. Periodontal and implant surgery have successfully incorporated several adjuvant therapies to promote tissue and bone regeneration, but multiple studies of different regenerative techniques in endodontic surgery have reported mixed results. Liu et al from Sun Yat-sen University, China, published a systematic review and meta-analysis to evaluate the results from multiple studies that looked at various materials used to aid and encourage regenerative healing in endodontic surgery.

Endodontic literature includes studies of multiple materials used during surgery to assist regenerative healing; these materials fall into 3 categories:

- **barrier membranes:** nonbioresorbable expanded polytetrafluoroethylene (e-PTFE) and bioresorbable collagen
- **bone grafts:** autografts, calcium phosphate, hydroxyapatite and demineralized, freeze-dried bone allografts
- **autologous platelet concentrates (APCs):** platelet-rich plasma (PRP) and platelet-rich fibrin (PRF)

Barrier membranes prevent the apical migration of epithelial cells, facilitating the repopulation of the bony defect by osteogenic cells. Bone grafts supply cells that assist bone growth, maintain space needed for new bone formation and create scaffolding to host new growth. APCs, derived from the patient's own blood, contain growth factors that stimulate cell proliferation, matrix remodeling and angiogenesis.

The researchers found 11 randomized controlled trials with ≥1 year of follow-up that evaluated regenerative techniques and materials in endodontic surgery. Studies used collagen membranes alone and in combination with bovine-derived hydroxyapatite; e-PTFE membranes alone and in combination with synthetic bioactive grafts; calcium sulphate grafts alone; PRP in combination with bovine-derived hydroxyapatite; and PRF alone. The meta-analysis showed that, overall, regenerative techniques significantly improved outcomes of endodontic surgery.

However, not all techniques and materials were equally effective. The use of e-PTFE membranes without grafting resulted in no added benefit for wound healing, while the use of collagen membranes alone demonstrated a trend toward better outcomes, although that trend did not reach significance. The use of APCs showed a similar result. Significantly improved healing rates were found in periapical defects filled with bovine-derived hydroxyapatite and covered with collagen membranes.

Conclusion

The evidence from this review was limited by several studies with small sample sizes and insufficient data on lesion type and size. Moreover, few endodontic studies have analyzed the use of newer, alternative PTFE membranes, and high-level evidence for APC use remains sparse. Although larger trials are needed to evaluate specific regenerative techniques, therapies such as barrier membranes, bone grafts and APCs adjuvant to endodontic surgery show promise for improved healing of periapical lesions.

Liu TJ, Zhou JN, Guo LH. Impact of different regenerative techniques and materials on the healing outcome of endodontic surgery: a systematic review and meta-analysis. Int Endod J *2021;54:536-555.*

In the next issue:

- Periapical lesions after root canal treatment
- Microsurgery outcomes and predictors
- Traumatic dental injuries and pulp sequelae

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