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update on endodontics™

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Volumetric Healing After Periapical Microsurgery

A combination of tools and techniques introduced in the 1990s—the dental operating microscope, ultrasonic root-end preparation and biocompatible root-end fillings—resulted in a revision of endodontic procedures termed "periapical microsurgery" that raised the success rate of surgical endodontic therapy from 45% to 60% to more than 90%. Although the literature shows that periapical tissue, the cortical plate and the gingiva experience rapid healing at a histologic level after periapical microsurgery, these reports are based on 2-dimensional imaging, which limits the ability to diagnose 3-dimensional (3-D) changes in structures surrounding the teeth. Thus, studies have focused on healing and reformation of the cortical plate rather than volumetric healing and corresponding site maintenance over time. Inadequate site preservation could make later implant placement problematic.

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Crossen et al from the University of North Carolina School of Dentistry used cone-beam computed tomography (CBCT) to establish 4-dimensional (3-D plus time) volumetric healing patterns, focusing on the buccolingual width of the bone and the surface contour of the cortical plane at 1 year after surgery. They studied 12 patients aged 18 to 65 years at the time of surgery (half of whom were aged >50 years) who had had a CBCT scan performed ≤3 months before surgery and who had attended a recall examination 1 to 6 years after surgery. Volumetric analysis of the buccal cortical plate showed a median change of –24.9 mm^3 over a median of 25 months.

Conclusion

While the loss of nearly 25 mm^3 in bone may appear significant, the authors stressed that this loss actually demonstrated the occurrence of little to no regression of the buccal cortical plate. Given that total bone regression was measured over the total area of the surgical site, this loss is equivalent to <0.25 mm linear cortical plate regression averaged over the surgical site surface area. This study showed that healing after periapical microsurgery without

grafts occurs with minimal buccal cortical plate regression.

Crossen D, Morelli T, Tyndall DA, Tawil PZ. Periapical microsurgery: a 4-dimensional analysis of healing patterns. J Endod *2019; doi:10.1016/j.joen.2018.11.002.*

Apical Lesions and Cardiovascular Risk In Young Adults

Chronic apical periodontitis, an inflammation of the apical periodontium, typically results in an osteolytic apical lesion of endodontic origin, most frequently presenting as asymptomatic apical periodontitis. Studies have shown an epidemiological connection between apical lesions of endodontic origin (ALEOs) and cardiovascular diseases, including endothelial dysfunction, atherosclerosis and coronary heart disease. While an elevated systematic inflammatory burden significantly influences the development and progression of cardiovascular disease, no study has yet established a biologic connection between cardiovascular disease and chronic apical periodontitis.

Many inflammatory bioactive molecules associated with cardiovascular disease can be used to predict future events. In particular, elevated levels of high-sensitivity C-reactive protein (hsCRP) represent the only valid standardized biomarker to predict risk of cardiovascular disease. But the studies that might link elevated hsCRP levels with apical periodontitis failed to control for other cardiovascular risk factors and age. To establish or reject a biologic link between apical periodontitis and cardiovascular disease, Garrido et al from Universidad de Chile measured inflammatory serum markers for cardiovascular risk, including hsCRP, in young adults with and without ALEOs.

Table 1. *Association between ALEOs and hsCRP levels ≥1 mg/L.*

Model	Odds ratio (95% confidence interval)
ALEO presence	6.8 (2.0–23.3)
Number of ALEOs	3.3 (1.3–8.9)
Adjusted for oral health factors[a]	5.1 (1.3–20.4)
Adjusted for classic cardiovascular risk factors[b]	12.8 (2.4–67.1)

All values significant at p < .05.
[a]DMFT index and probing depth.
[b]Age, sex, smoking, education level, hypertension, BMI, dyslipidemia and glycated hemoglobin.

The study included patients 18 to 40 years of age who were treated at a university dental clinic between 2012 and 2017. Patients with a clinical diagnosis of asymptomatic apical periodontitis who had never undergone endodontic treatment and were free of current acute or chronic systemic disease met the inclusion criteria; obese patients and those with moderate-to-severe marginal periodontal disease were excluded.

An ALEO was defined as ≥1 radiographic radiolucency (≥3 mm) in a tooth with extensive caries and negative clinical tests of pulp sensitivity. The cohort was then split into 2 groups:

- patients with ALEOs
- patients without ALEOs (controls)

Classic cardiovascular risk factors, including sex, level of education completed, smoking status, body mass index (BMI), blood pressure, lipid profile and glycated hemoglobin, were assessed.

The 2 groups were statistically similar for traditional cardiovascular risk factors as well as for pathobiological determinants of atherosclerosis in youth score, a methodology that estimates cardiovascular risk in young adults. The ALEO group had higher rates of mild periodontitis, as well as a significantly worse decayed/missing/filled teeth (DMFT) index, probing depths and clinical attachment levels, as would be expected because these measures are associated with poorer oral health status. ALEO patients had a 6.8× greater risk for higher levels of hsCRP; each additional apical lesion of endodontic origin increased the risk 3.3×. Multivariate analyses controlling for classic cardiovascular risk factors and for oral risk factors also showed that the ALEO presence significantly increased hsCRP levels (Table 1).

Conclusion

This study demonstrated that ALEO presence is significantly associated with elevated inflammatory serum markers of cardiovascular risk in young adults. These results strongly support a mechanistic connection

between periodontal disease and cardiovascular risk. To minimize risk of future cardiovascular disease, young adults with ALEOs should be referred for treatment.

Garrido M, Cárdenas AM, Astorga J, et al. Elevated systemic inflammatory burden and cardiovascular risk in young adults with endodontic apical lesions. J Endod *2019;45: 111-115.*

Endodontic Treatment to Resolve Retrograde Peri-implantitis

Peri-implant mucositis, which resembles gingivitis around natural teeth, may progress to peri-implantitis, a pathological inflammatory condition that occurs in the coronal portion of dental implants and leads to progressive loss of supporting bone. Prevalence of these conditions is high, with peri-implantitis occurring in nearly 20% and peri-implant mucositis in nearly half of all patients; up to 10% of all implants placed must be removed due to peri-implantitis. Increased risk of developing peri-implantitis has been linked to a history of chronic periodontitis, poor plaque control and a lack of regular peri-implant maintenance treatment.

Typically, retrograde peri-implantitis, limited to the periapex of osseointegrated implants, leads to the failure of the implant to completely osseointegrate. Retrograde peri-implantitis presents with radiographic bone loss associated with the apical area of the osseointegrated implant, resulting in clinical signs of inflammation with or without an abscess or sinus tract anytime from a few days to 4 years after implant placement.

Etiology of retrograde peri-implantitis remains unclear, but current literature suggests it may be caused by 1 of the following:

- an endodontic infection of an adjacent tooth
- residual microorganisms present after extraction of the infected tooth
- excessive heat or compression at implant placement
- implant apex contamination at implant placement

Some articles have also suggested viral infections as a possible factor. Treatment often includes surgery on the affected implant.

Sarmast et al from the University of Texas Health Science Center at Houston recently reported the successful nonsurgical treatment of 2 patients with retrograde peri-implantitis.

FIRST CASE: A 58-year-old man, referred for possible implant therapy on severely resorbed posterior mandibular edentulous ridges, underwent guided bone regeneration at sites #18 and #19. At the same time, tooth #20 received a buccal subepithelial connective tissue graft to cover a cervical defect and achieve root coverage. Two implants were placed 7 months later.

When the implants were uncovered 9 months later, imaging revealed a periapical radiolucency at the apex of tooth #20 and the apex of the implant at #19. Subsequent testing revealed that tooth #20 suffered from pulp necrosis and asymptomatic apical periodontitis, while implant #19 was diagnosed with retrograde peri-implantitis.

The patient and practitioner decided to attempt a nonsurgical treatment. Orthograde root canal treatment was performed on tooth #20. Following a 2-visit treatment, tooth #20 was restored with a crown. Radiographs showed evidence of healing of the periapical radiolucency at both tooth #20 and at implant #19.

SECOND CASE: A 66-year-old man underwent guided bone restoration prior to implant placement at sites #29 and #30. Although tooth #28 was asymptomatic, tested normal, and failed to show problems either clinically or radiographically, it was diagnosed with pulp necrosis and asymptomatic apical periodontitis when the implants were due to be uncovered. Imaging showed a periapical radiolucency at the apex of tooth #28 and at implant #29. Orthograde root canal therapy was performed on tooth #28; at follow-up, both periapical radiolucencies had resolved.

Conclusion

At follow-up (2 years for the first patient and 6 months for the second), the patients remained asymptomatic. With the chance of developing retrograde peri-implantitis in an implant adjacent to a tooth with an apical lesion at about 1 in 4, a nonsurgical endodontic approach should be the first treatment option to resolve retrograde peri-implantitis.

Sarmast ND, Wang HH, Sajadi AS, et al. Nonsurgical endodontic treatment of necrotic teeth resolved apical lesions on adjacent implants with retrograde/apical peri-implantitis: a case series with 2-year follow-up. J Endod *2019;doi:10.1016/j.joen.2019.01.002.*

Long-term Outcomes of Apical Surgery Using MTA

After failure of root canal treatment, apical surgery with retrograde obturation may be a good alternative when conventional orthograde re-treatment cannot be accomplished. Successful surgery requires placing a root-end filling to prevent possible bacterial reinfection. The ideal root-end filling material should be biocompatible, bioactive, stable, insoluble, and have no mutagenicity; it should also be easy to handle and cost-effective. Mineral trioxide aggregate (MTA), which has been used for >2 decades, has demonstrated high rates of success as a root-end filling. However, only 1 small study has reported success rates for treatment using MTA after >5 years.

von Arx et al from the University of Bern, Switzerland, reported 1-, 5- and 10-year results for a large group of patients who had undergone apical surgery with MTA used as the root-end filling for re-treatment of failed root canal treatment. All 195 patients had been treated by the same surgeon at a specialty clinic of a university dental school between 2001 and 2007. The surgeon accessed the root via a full mucoperiosteal flap, then performed an osteotomy followed by a root-end resection. After removal of all the periapical pathologic tissue, the cavity was filled with MTA, the flap repositioned and the wound sutured.

All patients were invited to a follow-up appointment 1 year after surgery. Those respondents later received an invitation to a 5-year follow-up, and responders at 5 years received an invitation to a 10-year follow-up. Based on clinical and radiographic results, healing at the roots was categorized as 1 of the following:

- complete healing
- incomplete healing (scar tissue formation)
- uncertain healing
- unsatisfactory healing

Teeth in the final 3 categories were grouped together as not healed. Teeth showing clinical signs or symptoms were classified as not healed, regardless of radiographic findings.

The failure rate remained consistently <10% at both the 1- and 5-year follow-ups. However, the rate more than doubled at the 10-year follow-up (Table 2). Of the teeth judged as healed at the 1-year follow-up, 87% remained so at the 10-year follow-up. Possible confounders, including age, sex, type of MTA used (gray vs white), and type of surgery (first time vs repeat), demonstrated no effect on outcome. Mandibular molars and maxillary premolars had a lower rate of healed cases than did maxillary molars, which healed in >95% of cases.

Table 2. *Outcome assessment of teeth undergoing apical surgery using MTA (n = 195) at 1, 5 and 10 years.*

Outcome	1-year follow-up (n = 190) n	%	5-year follow-up (n = 152) n	%	10-year follow-up (n = 119) n	%
Healed	174	91.6	139	91.4	97	81.5
Not healed	16[a]	8.4	13[b]	8.6	22[c]	18.5

[a]Includes 3 cases extracted due to failure before 1-year follow-up. [b]Includes 7 cases extracted due to failure before 5-year follow-up. [c]Includes 14 cases extracted due to failure before 10-year follow-up.

Conclusion

The first of its size and length of follow-up, this clinical study of apical surgery with MTA used for re-treatment of failed root canal therapy, demonstrated excellent results after 1 and 5 years. While the rate of healed teeth declined at 10 years, teeth judged to be healed at 1 year showed greater success at 10 years than did those that had not healed at 1 year. Treatment was most successful in maxillary molars.

von Arx T, Jensen SS, Janner SFM, et al. A 10-year follow-up study of 119 teeth treated with apical surgery and root-end filling with mineral trioxide aggregate. J Endod *2019;doi:10.1016/j.joen.2018.12.015.*

In the next issue:

- Presence of isthmi in mandibular mesial roots
- Outcomes of nonsurgical multiple-visit root canal re-treatment
- Evaluation of healing after endodontic microsurgery

Do you or your staff have any questions or comments about **Update on Endodontics**? Please call or write our office. We would be happy to hear from you.