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Anatomic Analysis of Maxillary Molars: New Findings

Successful endodontic treatment requires a thorough understanding of root anatomy. Increasingly sensitive imaging systems have significantly added to our knowledge. Recently, Divine et al from the University of Minnesota School of Dentistry conducted a study of the palatal root and canal system of maxillary first and second molars using micro–computed tomography (µCT) scanning with the goals of

- quantifying the dentin dimension of the root to determine any weak areas
- verifying the cross-sectional width of canals along the length of the root
- documenting the presence of lateral canals, apical ramifications and other anatomic features
- classifying apical constriction anatomy and canal curvature

The researchers scanned 47 previously extracted maxillary molars (30 first molars and 17 second molars) with complete root development, intact palatal roots, no resorption, no radicular caries and no previous endodontic treatment using µCT scanning. They measured dentin width, canal diameter, apical ramifications, root length, presence and location of lateral canals, canal curvature, and apical constriction.

Moving coronally, dentin increased, with first molars having significantly less palatal dentin at 8.0 mm to 11.0 mm from the apex than did second molars. The average mesiodistal canal dimension was greater than the buccolingual dimension, with the mesiodistal canal width at 13.0 mm to 15.0 mm from the apex, significantly wider in first molars than in second molars. Neither root length nor the number of apical exits differed between first and second molars, nor did the level of canal exit or branching. Slightly more than 40% of palatal roots had lateral canals. The degree of canal curvature did not correlate with root length, dentin dimension or canal width. Fewer than one-quarter of all roots showed apical constriction.

Conclusion

These findings from µCT scanning suggested possible adjustments to best

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practices for endodontic treatment of molars. The authors recommended the use of at least a 40-size master apical file with a 0.04 taper in order to properly instrument the canal. A greater percentage of lateral canals were removed with a resection level of 3.5 mm, an increased depth from the generally recommended level of 3.0 mm. Because most of the canals did not demonstrate any apical constriction, which creates an increased risk of extrusion, careful attention must be paid to irrigation techniques, working length and materials selected for obturation.

Divine KA, McClanahan SB, Fok A. Anatomic analysis of palatal roots of maxillary molars using micro–computed tomography. J Endod *2019;45:724-728.*

Apical Periodontitis Associated with Cardiovascular Disease

The first peer-reviewed study linking cardiovascular disease and oral health was published more than 3 decades ago. Subsequent studies have established an association between periodontal and cardiovascular diseases. Despite similar factors shared by both apical periodontitis and cardiovascular disease, including serum levels of inflammatory markers and common gram-negative anaerobic microbes, no cause–effect relationship has been established.

Endothelial dysfunction, which may be caused by chronic inflammation and be a potential contributing factor to atherosclerosis, has been found in young men with apical periodontitis. Three different techniques are most commonly used to measure endothelial dysfunction:

- angiography
- flow-mediated dilatation (FMD)
- venous plethysmography

Of these 3, only FMD, a measure of the endothelium's ability to cause vasodilation, is noninvasive and thus suitable for use with asymptomatic patients. Another noninvasive technique, carotid intima-media thickness (c-IMT) as measured by ultrasound, can identify atherosclerosis in its early stages; an increase in c-IMT raises the risk of both stroke and myocardial infarction. Chauhan et al from the Post Graduate Institute of Dental Sciences, India, conducted the first published study using FMD and c-IMT to investigate a potential association between apical periodontitis and cardiovascular disease.

The study enrolled 60 healthy men aged 20 to 40 years with radiographic evidence of apical periodontitis. Patients with chronic periodontitis, nonendodontic lesions in the maxilla or mandible, diabetes, arterial hypertension, dyslipidemia, left ventricular hypertrophy, or a history of cardiovascular disease, and those who smoked or were obese were excluded. Sixty healthy men matched by age, body mass index, and physical characteristics who were free from clinical and radiographic evidence of apical periodontitis formed the control group. All members of both groups underwent 3 FMD scans of the right brachial artery; after being administered nitroglycerin, all enrollees underwent another FMD scan. c-IMT was measured via an ultrasound examination of the right common carotid artery.

Patients in the group with apical periodontitis had significantly more carious teeth than did patients in the control group. They also had a significantly worse FMD percentage and a thicker c-IMT (Table 1). A significant inverse correlation was found between the presence of carious teeth and FMD percentage, as well as between c-IMT and FMD percentage. The finding of no difference between the groups after administration of nitroglycerin showed that both groups retained the potential to achieve maximum vasodilation, meaning that the level of vascular smooth muscle function did not influence the results.

Conclusion

The results of this study showed that patients with apical periodontitis

Table 1. *Comparison of baseline diameter, FMD %, nitroglycerin % and c-IMT between patients with apical periodontitis (AP) and controls.*

Variable	AP group (mean ± SD)	Control group (mean ± SD)	*p* value
Diameter of brachial artery (mm)	3.78 ± 0.52	3.73 ± 0.49	.55
FMD (%)	4.90 ± 2.05	9.74 ± 2.59	<.05
Nitroglycerin (%)	20.03 ± 3.05	20.05 ± 2.31	.96
c-IMT (%)	0.64 ± 0.12	0.54 ± 0.08	<.05

SD, standard deviation.

demonstrate both a greater c-IMT and impaired FMD, both linked to endothelial dysfunction. These findings reaffirm the potential association between endodontic infection and cardiovascular disease.

Chauhan N, Mittal S, Tewari S, et al. Association of apical periodontitis with cardiovascular disease via noninvasive assessment of endothelial function and subclinical atherosclerosis. J Endod *2019;45:681-690.*

Prescribing Antibiotics for Irreversible Pulpitis

With drug-resistant infections on the rise in the United States, experts have suggested that a major contributing factor is the unnecessary prescribing of antibiotics by medical professionals. Because dentists have overprescribed antibiotics for treating endodontic and orofacial infections—they wrote 25.7 million prescriptions for antibiotics in 2014 alone—several bacterial isolates from these infections are becoming resistant to common antibiotics.

The American Association of Endodontics and the European Society of Endodontology have issued evidence-based guidelines for antibiotic use in the treatment of endodontic infections. These guidelines state that only a few conditions, such as oral infection with evidence of systemic spread, including lymphadenopathy and trismus, require antibiotic therapy.

Despite evidence showing that antibiotic therapy does not relieve pain in symptomatic irreversible pulpitis, many dentists still prescribe antibiotics in these situations. A recent study undertaken by Agnihotry, a private practitioner from California, et al attempted to identify trends in the prescribing habits of general dentists to treat irreversible pulpitis.

The authors conducted an online survey of members of the Academy of General Dentistry (AGD) and the Academy of Operative Dentistry (AOD). Five survey questions classified the respondents' practice area and experience. The sixth question asked about the respondents' prescribing practices when treating irreversible pulpitis in a permanent tooth, with the following 6 options:

- Immediately prescribe antibiotics and schedule root canal treatment later
- Immediately prescribe analgesics and schedule root canal treatment later
- Immediately prescribe both antibiotics and analgesics and schedule root canal treatment later
- Prescribe analgesic and perform concurrent pulpectomy
- Prescribe antibiotics and perform concurrent pulpectomy
- Prescribe both antibiotics and analgesics and perform concurrent pulpectomy

The identity of all respondents was kept anonymous.

Of the 403 participants in the survey, >96% were general dentists; the remainder were prosthodontists.

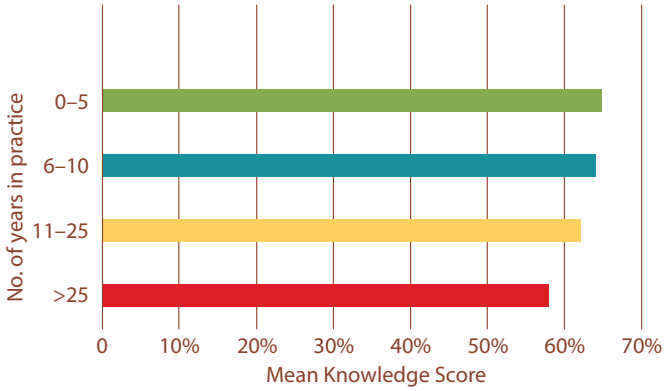

Figure 1. Mean knowledge score and years of practice of dentistry of the participants.

Slightly fewer than half were working toward or had completed an advanced training program (Advanced Education in General Dentistry [AEGD], General Practice Residency [GPR], Operative Dentistry Graduate Program or Prosthodontics Residency). The mean years of practice for all participants was 22 years.

Among the participants, 39.3% reported that they would prescribe antibiotics for irreversible pulpitis affecting a permanent tooth without any signs of systemic infection. There was a trend toward reduced knowledge (i.e., increased antibiotic prescribing) in dentists with more experience, although the difference was not significant (Figure 1). Participants with advanced training scored significantly higher than did the participants with primary dental (Bachelor of Dental Surgery [BDS]/Doctor of Dental Surgery [DDS]/Doctor of Medicine in Dentistry [DMD] only) qualifications.

Conclusion

Data from the Centers for Disease Control and Prevention show that every year 2 million drug-resistant infections cause 23,000 deaths in the United States. Despite convincing evidence that antibiotics do not help control pain resulting from irrevers-

ible pulpitis, more than one-third of respondents in this study admitted to prescribing antibiotics in these cases. While overprescribing antibiotics is not unique to oral health practitioners, dentists need to understand the consequences of prescribing antibiotics when the practice is not supported by evidence-based guidelines.

Agnihotry A, Gill KS, Stevenson RG III, et al. Irreversible pulpitis–a source of antibiotic over-prescription? Braz Dent J *2019; doi:10.1590/0103-6440201902873.*

Evaluating Different Irrigation Systems In Endodontic Treatment

Failure to eliminate pathogens in the root canal during endodontic treatment allows the progression of apical periodontitis to destroy mineralized tissue around the root apex. A fundamental part of treatment involves irrigating the prepared canal with antimicrobial solution. The most commonly used method is conventional irrigation by positive pressure, but this technique carries with it a greater possibility of irrigation solution extrusion into the periapical region. The development of passive ultrasonic irrigation attempted to address this issue, as did the development of a negative apical pressure protocol.

Unfortunately, in vivo studies of these 3 options have shown that none of them remove all microbes from the root canal system. To evaluate which of these protocols achieves the greatest level of success, Feitoza de Jesus et al from the Universidade de São Paulo, Brazil, conducted a study comparing these 3 techniques using an animal model to determine which one led to the highest level of periapical repair in teeth with apical periodontitis and lowest level of inflammatory mediator expression, an indicator of the level of infection.

The study involved 40 dogs' teeth (80 root canals) in which apical periodontitis was induced. After 10 teeth were set aside as a control group, the remaining teeth underwent a standard endodontic procedure using 3 different irrigation protocols:

- **Group 1:** apical negative pressure irrigation (EndoVac; Discus Dental, Culver City, Calif.)
- **Group 2:** irrigation using a standard 30-G needle followed by passive ultrasonic irrigation using an Irrisafe tip (Satelec; Acteon Group, Merignac, France)
- **Group 3:** conventional irrigation using a standard 30-G needle and positive pressure

Each irrigation protocol used a sequence of 30 seconds of 5.25% sodium hypochlorite (NaOCl), 30 seconds of 17% ethylenediaminetetraacetic acid (EDTA) and another 30 seconds of 5.25% NaOCl. Teeth in group 2 received 20 seconds of passive ultrasonic irrigation between the irrigation solutions.

At 180 days, radiographic evaluation of the root canals showed a persistence of periapical radiolucent areas and discontinuity of the lamina in 35% of group 1 teeth, 40% of group 2 teeth and 40% of group 3 teeth, an insignificant difference. Immunohistochemical evaluation for osteopontin, tumor necrosis factor-α and interleukin 1-α, 3 factors that influence the development of inflammation and the immune response, also revealed no difference among the 3 protocols.

Conclusion

Given that approximately 60% of the treated teeth achieved repair of apical periodontitis after endodontic treatment regardless of the irrigation protocol employed, this study suggested that the choice of irrigation protocol may be left to the discretion of the practitioner. Further, larger studies should be undertaken to see if any outcome differences can be discovered.

Feitoza de Jesus S, Cohenca N, Coutinho Romualdo P, et al. Radiographic and immunohistochemical evaluation of root canal treatment using different irrigation systems. Braz Dent J *2019;30:123-132.*

In the next issue:

- Effect of occlusal reduction on postoperative pain
- Apical periodontitis and Inflammatory mediators
- Quality of life with restored endodontically treated teeth

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