

A Professional Courtesy of:



Raaed Batniji, DMD
Samir Batniji, DDS

Your ENDODONTIC SPECIALTY

www.endodontic.net

1111 S. Grand Ave., Ste. D
Diamond Bar, CA 91765
909-396-9944 • Fax: 909-396-9984

1111 W. Covina Blvd., Ste. 130
San Dimas, CA 91773
909-592-9197 • Fax: 909-592-8860

9353 Fairway View Place, Ste. 210
Rancho Cucamonga, CA 91730
909-945-5008 • 909-243-7575
Fax: 909-581-6668



Successful Endodontic Treatment in Cracked Teeth

The American Association of Endodontists classifies tooth cracks or fractures into 5 subgroups: craze lines, fractured cusps, cracked tooth, split tooth and vertical root fracture. Cracked teeth were defined as “green-stick” fractures with a history of cold sensitivity and acute pain upon chewing.

The proper treatment of cracked teeth requires a determination of tooth restorability and pulpal status. In teeth with irreversible pulpitis or necrosis, root canal treatment should be undertaken only if the teeth are restorable. Teeth with deep pockets associated with the crack but no other signs of periodontal bone loss are rarely restorable. Whether

Inside this issue:

- Effect of Age on Root Canal Configurations
- Removal of Separated Instruments from Root Canals
- Root Canal Bacteria and Apical Periodontitis

cracked teeth with necrotic pulps should be treated or extracted remains an open question.

Because long-term studies of treatment outcomes for cracked teeth receiving ortho-

grade root canal treatment in the United States do not exist, Krell and Caplan from the University of Iowa analyzed the 1-year outcomes for such teeth treated by 1 private practice endodontist over a 25-year period. Teeth were filled using the lateral condensation technique and Roth's 801 sealer. All patients received recall cards 1 year after treatment, at which time they were evaluated for the presence or absence of symptoms, radiographic resolution of previous lesions and the presence of a crown. If no signs or symptoms were seen and any previous pathosis seen on radiographs had resolved with the development of no new pathosis, the treatment was deemed a success.

All teeth included in the analysis had cracks confirmed by direct visualization. Cusp fractures, split teeth and teeth with vertical root fractures were excluded from the analysis. Of the 2086 patients seen with at least 1 cracked tooth, 1406 underwent root canal therapy; 363 patients who returned for follow-up at 1 year were included in the analysis. Success at 1 year was seen in 296 teeth (82%). The 3 variables that best predicted failure were

- teeth with marginal ridge cracks
- teeth with mesial or distal probing pocket depths of ≥ 5 mm

- periapical diagnosis of chronic apical periodontitis (CAP), suppurative apical periodontitis (SAP) or acute apical abscess (AAA)

Based on these results, the authors created a novel prognostic index (Figure 1) for successful orthograde root canal therapy in cracked teeth, rated from most likely to least likely to succeed:

- **Iowa stage I:** no probing pocket depths ≥ 5 mm; no crack across the distal marginal ridge
- **Iowa stage II:** no probing pocket depths ≥ 5 mm; crack present across the distal marginal ridge; no periapical diagnosis of CAP or SAP or AAA
- **Iowa stage III:** no probing pocket depths ≥ 5 mm; crack present across the distal marginal ridge; a periapical diagnosis of CAP or SAP or AAA
- **Iowa stage IV:** ≥ 1 mesial or distal probing pocket depth ≥ 5 mm

Conclusion

Of course, standard treatment methods and technology have evolved over the 25 years covered by this study; for example, the endodontist incorporated nickel-titanium instrumentation 10 years after beginning private practice. Overall, the results of this study suggested that root canal treatment in cracked teeth may have a higher rate of success than had been previously reported.

Krell KV, Caplan DJ. 12-month success of cracked teeth treated with orthograde root canal treatment. J Endod 2018;doi:10.1016/j.joen.2017.12.025.

Effect of Age On Root Canal Configurations

Studies of patients ≤ 20 to ≥ 40 years of age have shown that both pulp chamber size

and root canal diameter decrease as people age. Such changes may also result from carious lesions, deep restorations and periodontal disease. Although many studies appear to support these conclusions, their applicability is limited due to studies' restriction to a single type of tooth, a single root, a specific extra canal in a specific root or a specific root canal configuration. Additionally, small sample size has been a problem with these studies.

Martins et al from the University of Lisbon, Portugal, used cone beam computed tomography (CBCT) to analyze the prevalence of root canal systems in a large population of various ages (mean age, 51 years). They evaluated CBCT examinations performed over a 5-year period in 670 patients (243 males, 421 females).

All teeth were included in their study except for third molars, teeth with previous endodontic treatment, and teeth with immature apices or root

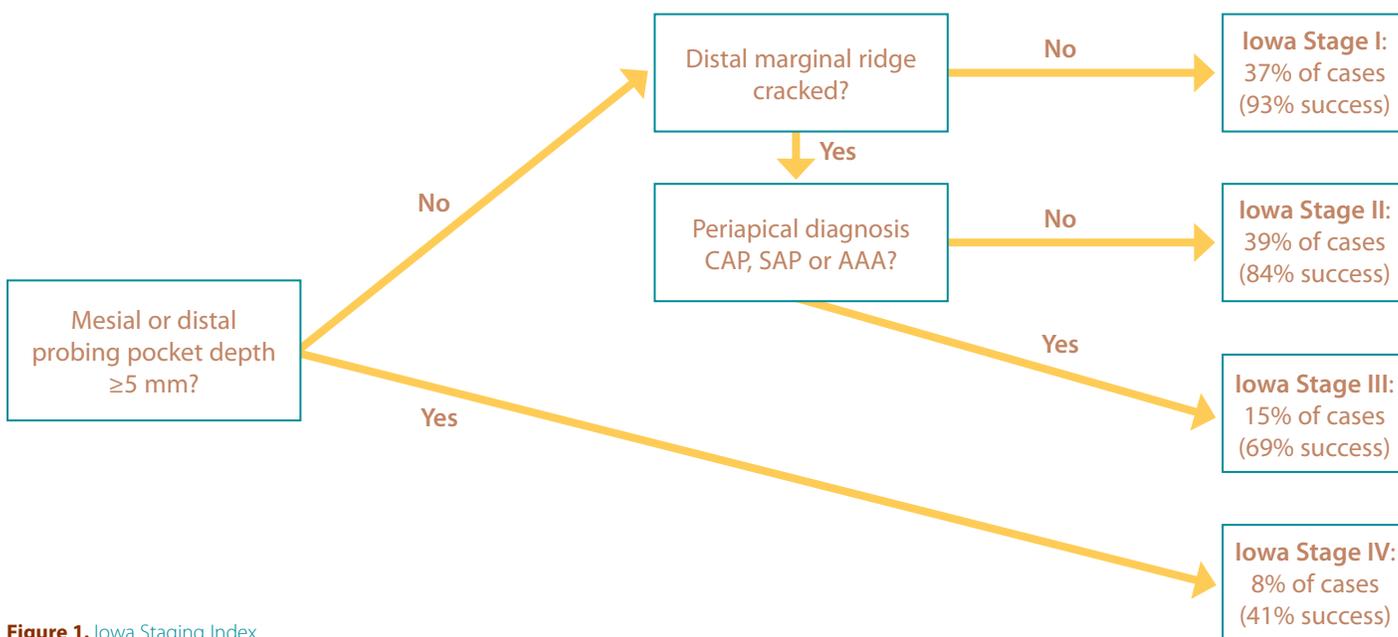


Figure 1. Iowa Staging Index.

resorption, for a total of 12,325 teeth. Root canal systems were classified by Vertucci type. Patients were divided into 4 groups by age: ≤ 20 years; 21 to 40 years; 41 to 60 years; and ≥ 61 years.

Information for only 151 teeth was available for the patient group that was ≤ 20 years old; because of the scarcity of data, that group was not included in the statistical analysis.

The second maxillary molar showed the greatest variation of all the maxillary teeth, with a progressive decrease in Vertucci type I configuration (single canal from crown to apex) and a corresponding increase in Vertucci type II configuration (2 canals near the crown reuniting into 1 canal near the apex).

The distal root of the mandibular first molar showed a decrease in Vertucci type I prevalence in patients ≥ 61 years old. Several other mandibular teeth showed a similar pattern of decrease in Vertucci type I configurations, but the differences were not as substantial. The root canal configurations of most anterior teeth did not vary greatly by age.

Conclusion

This study demonstrated a tendency for a greater prevalence of Vertucci type I configuration in younger people than in older people. The older population also showed a large increase in the number of root canals, primarily in the maxillary and mandibular second molars and in the distal root of mandibular first molars. These considerations must be taken into account when planning endodontic treatment for older patients.

Martins JNR, Ordinola-Zapata R, Marques D, et al. Differences in root canal system configuration in human permanent teeth within different age groups. *Int Endod J* 2018;doi:10.1111/iej.12896.

Removal of Separated Instruments from Root Canals

Endodontic instrument fracture during root canal treatment occurs in 2% to 5% of cases.

Removal of instrument fragments in infected root canals or the coronal third of canals should be attempted if they cannot be successfully bypassed, because resultant persistent periapical infection and additional surgical treatment can increase patient morbidity and raise treatment costs. The American Association of Endodontists and the American Academy of Oral and Maxillofacial Radiology recommend cone beam computed tomography use to assess separated endodontic instruments.

Empirical risk evaluation may be established with 2-dimensional (2D) periapical radiography, used to evaluate major factors affecting the retrieval of separated instruments, such as the angle of canal curvature, the depth of the fragment and the fragment position relative to the curvature of the canal. Only the radius of the canal curvature cannot be measured using a 2D modality.

Tordai et al from the University of Pécs, Hungary, conducted an in vivo study to evaluate the value of periapical radiographs taken during treatment of separated endodontic instruments to assess preoperative case difficulty and predict instrument removal success. They studied results in 115 patients (123 instruments in 120 root canals in 115 teeth) treated between March 2005 and March 2015. Before treatment, teeth

were assessed for the type of tooth and root canal; site of the fragment in the root canal and in relation to the root canal curvature; type and length of the fragment; degree of root canal curvature; and radius of the root canal.

Fragments were removed using a microsonic technique. After the canal was enlarged coronally to the broken fragment, ultrasonic K-files mounted in a piezoelectric scaler were used to trephine around the obstruction. Successful cases saw complete removal of the fragment without perforation of the root canal.

Of the 123 fractured instruments, 97 fragments were removed. Three variables had a statistically significant impact on removal success:

- site of fragment in relation to the root canal curvature
- angle of the root canal curvature measured with the Schneider technique
- angle of the root canal curvature measured with the canal access angle technique

No variables were statistically associated with the failed cases. Root canal fillings with an ideal taper had significantly better outcomes with respect to obturation length.

Conclusion

Microsonic removal successfully retrieved and removed fragments of separated instruments. Perioperative radiographs can help evaluate the potential for treatment success but cannot precisely predict outcomes.

Tordai B, Schreindorfer K, Lempel E, Krajczár K. Factors affecting ultrasonic removal of separated endodontic instruments: a retrospective clinical study. *Quintessence Int* 2018;49:257-266.

Root Canal Bacteria and Apical Periodontitis

Primarily endodontic infections contain a mixed group of bacteria—in particular, anaerobic bacteria. The 9 species most often found in infected root canals of teeth with apical periodontitis, which is characterized by a localized periradicular immune response to infected root canals, include *Porphyromonas endodontalis*, *Fusobacterium nucleatum*, *Parvimonas micra*, *Streptococcus* species, *Dialister* species, *Filifactor alocis*, *Pseudoramibacter alactolyticus*, *Treponema* species and members of the Actinobacteria phylum.

The type and number of bacterial species occurring in infected canals can influence the clinical and radiographical manifestations of apical periodontitis because host cells release inflammatory mediators, proinflammatory cytokines and growth factors. Although having protective effects, this can also lead to tissue destruction and bone resorption.

During inflammatory and wound-healing processes associated with apical periodontitis, matrix metalloproteinases—particularly, subtypes 2 (MMP-2) and 9 (MMP-9)—may be released at increased levels. These enzymes may degrade components of the extracellular connective matrix and play an important role in the development of apical periodontitis. Takahama et al from the State University of Londrina, Brazil, undertook a study to evaluate the association between various bacterial species in the apical root canal and expression of inflammatory mediators involved in soft tissue and bone destruction.

Their study included 17 single-rooted teeth with associated periodontitis lesions extracted from 17 patients at a university oral surgery clinic. All teeth had extensive carious lesions and/or defective coronal restorations, along with pulp necrosis; roughly half the teeth were asymptomatic. None of the patients had significant periodontal disease.

Using real-time polymer chain reaction (PCR), teeth were evaluated for the presence of the 9 most commonly

found bacterial groups or species in the apical root fragments. Lesions underwent histopathological and immunohistochemical analyses that targeted MMP-2, MMP-9, receptor activator of NFκB (RANK), RANK ligand (RANKL) and osteoprotegerin.

All sample teeth tested positive for bacteria, with more than half testing positive for Actinobacteria species (Table 1). All 5 target mediators showed a high mean expression. Actinobacteria were significantly associated with granulomas; teeth with Actinobacteria

In the next issue:

- Revascularization-associated intracanal calcification
- Sequelae following traumatic dental injury in primary teeth
- Efficacy of endodontic irrigants on the removal of biofilm

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. ©2019

also presented significantly higher MMP-2 expression.

Conclusion

The results of this study suggest that infection by members of the Actinobacteria phylum plays an important role in the destruction of soft tissue and bone in apical periodontitis. More studies in this area can help establish the effect of complex host-bacteria interactions in these cases.

Takahama A Jr, Rôças IN, Faustino ISP, et al. Association between bacteria occurring in the apical canal system and expression of bone-resorbing mediators and matrix metalloproteinases in apical periodontitis. *Int Endod J* 2018;doi:10.1111/iej.12895.

Table 1. Frequency of detection of selected bacterial taxa

Bacterial taxa	Overall (%)
Universal (bacteria)	17/17 (100)
Actinobacteria species	9/17 (53)
<i>Streptococcus</i> species	6/17 (35)
<i>Fusobacterium</i> species	3/17 (18)
<i>Parvimonas micra</i>	3/17 (18)
<i>Dialister</i> species	2/17 (12)
<i>Porphyromonas endodontalis</i>	2/17 (12)
<i>Filifactor alocis</i>	1/17 (6)
<i>Pseudoramibacter alactolyticus</i>	1/17 (6)
<i>Treponema denticola</i>	0/17 (0)