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Contemporary Endodontic Evaluation and Diagnosis: Implications for Evidence-Based Endodontic Care

A Peer-Reviewed Publication
Written by Manish Garala, BDS, MS

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Educational Objectives

The overall goal of this article is to provide the reader with a contemporary, evidence-based perspective on endodontic diagnosis. Upon completion of this course, the reader will be able to do the following:

1. List and describe the considerations in determining a patient's chief complaint and the importance of obtaining an accurate dental history
2. List and describe the implications of pulpal exposure and the success rates of direct pulp therapy
3. List and describe the tests that should be performed to assess the status of the pulpal and periradicular health
4. List and describe the types of cracked teeth, testing that can be performed and the implications for treatment

Abstract

Endodontics has evolved as a truly scientific procedure and, when correctly diagnosed and performed, its research-reinforced statistics corroborate its high success rates. In order for a correct diagnosis to be made, a number of steps and tests are required. These include ascertaining the source of the patient's chief complaint, understanding the patient's dental history and performing pulp tests that are integral to the diagnosis. In addition, the possibility of cracked teeth and periodontal involvement must be considered and assessed during the diagnostic phase. Only after a complete examination has been performed and a definitive diagnosis obtained is it possible to create a treatment plan for successful endodontic treatment.

Introduction

Endodontics remains a cornerstone in the foundation for dental restorative care in the 21st century. Without successful endodontics, we are unable to provide many patients with two of their most important facets – their ability to smile while displaying their natural teeth and their ability to use their natural teeth to eat with pain-free function. A recent study by the American Association of Endodontists highlighted this, with a third of participants stating that they would not sell their front teeth for any amount of money.¹ Endodontics has evolved as a truly scientific procedure, and when correctly diagnosed and performed, its research-reinforced statistics corroborate its high success rates.² This is ultimately reflected by the high patient satisfaction with the procedure. Eighty-five percent of patients who have had endodontic treatment performed by an endodontist would return to him or her for future work. This serves to reinforce the concept that endodontic procedures are valuable treatment modalities for the person who we ultimately serve, the patient.

There are many myths and misconceptions in endodontics, and many of these have been addressed by the resurgence in endodontic research. This article provides the reader with a contemporary, evidence-based perspective on endodontic diagnosis that will enable clinicians to be secure

and confident in the knowledge that they are striving to provide quality endodontic care that follows guidelines and principles established from the latest endodontic research.

Endodontic Diagnosis

To perform successful endodontic treatment, it is first necessary to correctly diagnose the affected tooth or teeth. This diagnosis can often be simple where there is a large carious cavity and there are healthy, restoration-free adjacent teeth (Figure 1), or it can be extremely complex where the symptoms are less defined and there have been multiple endodontic procedures on numerous teeth (Figure 2). Irrespective of the details of the case, the same protocol of examination and testing should be employed in each instance in order to obtain the most precise response and establish an accurate diagnosis.

Figure 1. Periapical radiograph displaying a large carious cavity on tooth #3



This was identified as the symptomatic tooth by pulp testing. The adjacent teeth have no restorations, and there is no peri-radicular pathology evident with them.

Figure 2. Periapical radiograph with existing RCT of satisfactory technical status on teeth #2, #3 and #4, and coronal restorations



The Patient's Chief Complaint

An examination should always be initiated by obtaining the patient's chief complaint. This is critical, as it will provide information as to what symptoms or pathology our subse-

quent tests will be searching for. Otherwise, a patient may be referred or endodontic treatment performed on a non-offending tooth because this critical step was overlooked. In the case shown in Figure 3, the patient's chief complaint was pain with cold liquids. If this information had not been obtained, it would have been correct to perform endodontic treatment on tooth #19 due to the presence of a large carious lesion, a pulp exposure and the peri-radicular pathology present. However, this would not have alleviated the cold-sensitivity symptom. Such treatment is likely to create an unhappy patient. Diagnosis is typically more complex in this situation than for the case in Figure 1.

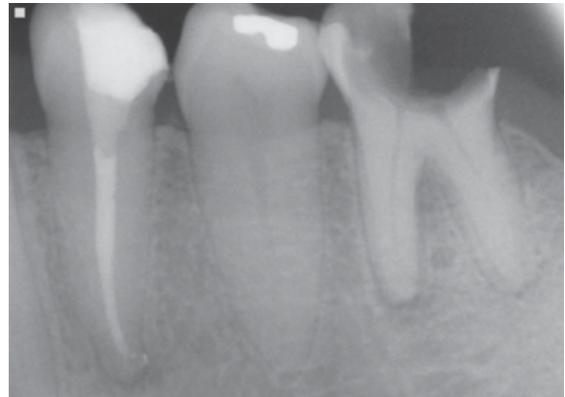
Figure 3. Two pre-operative radiographs from different horizontal angulations



Note the significant radiographic caries in tooth #19 that has extended into the pulp chamber, and the presence of a small peri-radicular radiolucency at the apex of the mesial root. There is also an associated furcation radiolucency. Tooth #21 has a distal occlusal cavity that does not appear to have penetrated radiographically into the pulp chamber. There is peri-radicular widening of the periodontal ligament space.

The greatest practice builder or opportunity to gain a patient's trust is to alleviate his or her dental pain. Accurate history taking and proper diagnosis confirmed that the tooth requiring treatment was actually tooth #21 (Figure 4). The confidence that this creates with patients is important for their acceptance of comprehensive dental care. It will still be necessary to treat tooth #19 due to its extensive caries, non-vitality and apical pathology, but this is not the primary source of the patient's concern at this time.

Figure 4. Post-operative radiograph following endodontic treatment on tooth #21



Tooth #21 was displaying symptoms to cold, consistent with the patient's chief complaint. Tooth #19 remained asymptomatic despite the pathology present and was subsequently treated endodontically.

The Patient's Previous Dental History

Understanding previous dental history is a critical step when obtaining information related to the chief complaint. It is important to determine whether a patient has had any recent dental treatment in the area where he or she is experiencing discomfort.

It is not unusual for patients who have had a scaling and root planing procedure to experience cold sensitivity due to exposure of dentinal tubules following calculus or cementum removal.³ For these patients, the discomfort related to cold stimuli should be immediate but also relieved without intervention within a few seconds. This type of sensitivity is reversible pulpitis and requires no endodontic treatment at the time. For management of these symptoms, a desensitizing agent (for example, Gluma) can be placed on the exposed sensitive surfaces. Gluma will cause the precipitation of plasma proteins from within the dentinal fluid to obstruct the tubules, thereby decreasing the fluid flow and dentin permeability.⁴ Patients should also be instructed to use a desensitizing dentifrice, such as Sensodyne or Crest Sensitive, that contains potassium nitrate for nerve ending desensitization. The presence of potassium oxalate in desensitizing products stimulates precipitate formation of potassium oxalate crystals, which further occlude the dentinal tubules.⁵ In most instances, these palliative measures will control the patient's discomfort and assist resolution of the symptoms. Should the patient's symptoms persist beyond a period of two weeks without any improvement, it may then be necessary to provide endodontic treatment to remove the pulp, thereby eliminating the tooth's reaction to the external stimulus. There are very few guarantees in clinical dentistry, but the elimination of cold pain once the pulp tissue has been properly removed from the pulp chamber and all the canals is one of these. This is an example of interceptive endodontic treatment and is necessary if the patient's symptoms cannot be managed by more conservative methods.

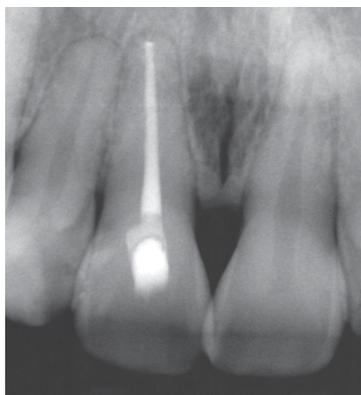
The placement of new filling restorations or crown/bridge abutment preparations also needs to be identified as part of the dental history. It is inevitable that any form of tooth reduction by caries formation, caries removal or mechanical preparation causes injury to the pulp.⁶ The pulp's capacity to repair is dependent on two factors: the extent of the injury and the existing pulpal health.⁷ The closer the restoration is placed to the pulp the greater the reduction in residual dentin thickness, and the greater the injury the pulp will experience.⁸ Based on the results of studies, it is generally accepted that the effects of pulpal insults, whether due to caries, restorative procedures or trauma, are cumulative and that with each succeeding irritation the pulp has a diminished capacity for repair and for remaining vital.

Figure 5a. Pre-operative radiograph highlighting the extensive canal space calcification in tooth #8 in comparison to tooth #9



It appears that the pulp attempted to heal by calcification of the canal space but was unsuccessful due to the development of symptoms.

Figure 5b. Post-operative radiograph



This radiograph demonstrates the ideal technical result that can be achieved with the use of high-power magnification to locate the canal and the conservative removal of the overlying canal calcification.

The pulp tissue's potential for repair is dependent on the presence of an adequate microcirculation within the pulp tissue and the absence of extensive pulpal calcifications (which are regarded as existing repairs of the pulp by scar formation) (Figure 5). The pulp in a young patient will have a greater capacity to repair than it will in an older adult patient, as it has

probably experienced fewer insults. Therefore, in the absence of acute, spontaneous and irreversible symptoms, younger patients should be given more time for the pulp to attempt repair and for spontaneous resolution of symptoms.

Types of restorations associated with irreversible pulpal damage

Studies have shown that crown/bridge abutment preparations produce some of the most damaging effects on the pulp. In one study, 16% of pulps became non-vital within a 10-year observation period, and 32% of previously confirmed vital pulps became necrotic following bridge abutment preparations. Anterior abutment preparations resulted in pulp necrosis in over 50% of teeth examined in the study.⁹ Previous studies found that pulp necrosis occurred 10-18% of the time following crown preparations on vital teeth.¹⁰ Patients should be forewarned of the possibility of endodontic treatment being required following extensive crown/abutment preparations.

Pulp Exposure

Pulp exposure during caries removal creates significant pulpal inflammation, especially since the pulp has already been chronically inflamed by the advancing proximity of the carious lesion to the pulp. Although it may be possible to provide some temporary relief from pulpal symptoms by performing a direct pulp capping procedure, it is inevitable in adult teeth with complete root formation that the pulp will eventually become necrotic and require endodontic treatment. The time frame for this to occur depends on the amount of existing pulpal inflammation and repair caused by previous insults, and the size of the pulp exposure.¹¹ Small carious pulp exposures (less than 1 mm² after complete caries removal) have a success rate of only 37% over five years and 13% over 10 years. When the exposures occurred, they were treated in controlled clinical conditions under rubber dam isolation and pulp capped using a hard-setting calcium hydroxide paste with a glass ionomer or zinc phosphate base. All the teeth that demonstrated success developed significant calcification of the pulp space (which is likely to make the endodontic procedure more challenging if the pulp capping procedure does eventually fail).¹¹

A mechanical pulp exposure during restoration preparation is different than a carious exposure. With the former, there tends to be limited existing pulpal inflammation prior to the exposure, tertiary dentin has not been laid down and there has not been an immunologic response to an advancing carious lesion. Furthermore, the exposure usually occurs in an environment that is relatively free of bacteria, which is in direct contrast to a carious exposure.

If it is decided that endodontic treatment is to be deferred at this time, and repair of the pulp exposure is to be performed, it should be considered that acid etching of dentin in close proximity to the pulp can cause severe chemical ir-

ritation of the pulp. This is significantly worse when the pulp is exposed, as recommended in the total etch technique for exposure repairs.¹²

Ideally, repair of the exposure site should be carried out under rubber dam isolation to prevent contamination of the exposure site, and the site should be closed using a hard-setting calcium hydroxide-based material or mineral trioxide aggregate (MTA, Dentsply, Tulsa OK) to prevent bacterial leakage and stimulate dentin bridge formation. The tooth will require monitoring, prior to permanent restoration placement, for signs of irreversible pulpitis development in order to ensure that the pulp has undergone the necessary healing. It may take 6-8 weeks until this can be confirmed by pulp testing and evaluation of symptoms. If the pulpal status is in doubt after this period of time, endodontics should be performed. This will eliminate the need to access the pulp chamber through the crown and potentially increase complications with canal location. It will also avoid the risk of fracture of a new crown.

Minimizing pulpal damage

Minimizing pulpal responses is achieved by using adequate water spray and coolant to prevent overheating or burning of the pulp. The use of a high-speed instrument that minimizes pressure on the pulp also decreases the risk of these undesired effects.¹³ When using an etching technique in cavities with minimal remaining dentin, care should be applied to protect the dentin from prolonged exposure to these strong acids. Dentin demonstrates significant permeability through its dentinal tubules, and this can cause further injury to the pulp, as the unpolymerized monomer also has the ability to leach directly into the pulp through the dentinal tubules.¹⁴ Polymerization shrinkage and microbial leakage are principal causes of pulpal irritation, as the shrinkage enables bacterial contamination of dentin in close proximity to the pulp. In these instances the effect can be compounded when there is a reduced amount of protective dentin present to protect the pulp.¹⁵ Further bacterial protection can be provided by using a base below bonded restorations, providing an additional layer for microbes present through leakage to overcome before they reach the inner layers of dentin and the pulp. Furthermore, the use of a calcium hydroxide base in very deep cavities will also prevent the cytotoxicity of restorative materials inhibiting the formation of tertiary dentin.¹⁶ The formation of tertiary dentin is critical for pulp repair following cavity preparation.

Pulp Testing

Irrespective of the dental history or the chief complaint, it is absolutely essential that pulp testing be performed before the decision is made to initiate endodontic treatment. If a patient is experiencing severe pain, and the offending tooth appears obvious, it is still judicious to test the surrounding teeth to ensure that they are not also affected or exacerbat-

ing the symptoms. It is disconcerting to hear from a patient the day after endodontic treatment has been provided that the discomfort has persisted in a manner identical to that experienced before treatment. This can be avoided by first ascertaining that the correct tooth has been identified as having the endodontic problem or that the surrounding teeth were affected as well. Although it is unlikely that two teeth are affected to the same extent or that they will display similar symptoms at the same time, this could well be true for quadrants or arches where preparations have been performed simultaneously.

Pulp testing should be carried out systematically and in an organized manner, enabling information that is obtained to be compared with that of the different teeth that are tested. An example of such an approach would be to perform the same test sequentially on all the teeth in the same sextant. The same tooth on the contralateral side could be used as a reference, and this is typically carried out for anterior teeth. Ideally, the opposing arch sextant should also be tested as part of the diagnostic process. This is mandatory when the patient is complaining of pain that refers between arches, irrespective of whether this pain has now localized. This methodical approach prevents the wrong tooth from being diagnosed as the culprit, and it also reassures the patient that there are no other teeth that could be stimulating the painful symptoms. At a minimum, the suspect tooth and the two teeth on either side of it should be tested. This will enable useful comparisons to be made among the responses obtained, which will assist in the development of a diagnosis and the isolation of the offending tooth.

Series of tests to be performed

The essential tests are outlined in Table 1. These tests focus on determining the pulpal status and the peri-radicular status of each tooth.

Table 1. Essential tests

DIAGNOSTIC TESTS		// Date:			
Tooth #					
Palpation					
Mobility					
Percussion					
Bite/Chewing					
Cold					
Heat					
EPT					
Transillumination					
Perio Probing					
Cavity Test					

The first test to be undertaken should not be the stimulus that the patient feels is responsible for triggering his or her presenting symptoms. It should also not be undertaken on the tooth that is suspected to be the source of the symptoms, thereby preventing the initiation of pain that may or may not subside quickly and consequently affect the results of the remaining tests.

Palpation Tests

The first series of tests serve to determine the peri-radicular status. Palpation tests are performed using firm pressure from an index finger on the buccal and lingual mucosa in the area of the root apex and then on the gingival margin of each tooth to be tested. This palpation will help to identify whether there is swelling present at the apex of these teeth or if there is severe apical inflammation. If present, the nature of the swelling should be identified to formulate a treatment plan for management, which could include no treatment, incision and drainage with or without an indwelling drain left in place, or trephination. Palpation testing around the gingival margin will help to determine whether purulent drainage through the buccal sulcus is present, providing information about the infection status of the peri-radicular tissues.

Identification of sinus tracts should also be performed at this time. The correct definition of a drainage point on the mucosa emanating from the peri-radicular tissue precludes the use of the word “fistula,” since this is defined as an opening between two epithelium-lined cavities or organs.¹⁷ This term is more appropriate for an opening created surgically between the sinuses and the oral cavity, which can happen during extraction of maxillary molars.

Mobility Test

The second test performed is a mobility test to determine tooth stability. Buccal to lingual movement of the tooth using a mirror handle and the index finger, or using the thumb and index finger, can help determine the amount of tooth mobility. This is rated on a scale of 1 to 3, with a grade 1 representing 1 mm of buccal to lingual movement, grade 2 representing 2 mm of buccal to lingual movement, and grade 3 being depressible by greater than 1 mm and with greater than 2 mm of buccal to lingual movement. If there is grade 2 or 3 mobility, it could be the result of a number of factors, including trauma, rapid orthodontic movement, root fractures or, most commonly, periodontal disease. Periodontal disease present would have to be confirmed by a periodontal examination and may or may not be related to endodontic etiology. This mobility should significantly improve following endodontic treatment if it is related to pulpal non-vitality. This test can also be valuable as it may elicit symptoms if there is significant periodontal ligament inflammation of the affected tooth.

Bite Test

The third test is usually a bite test. This is typically performed using a cotton-tipped applicator. Patients are instructed to close their teeth together on the end of the applicator, which is placed in the central area of the tooth to be tested (Figure 6). If any pain is elicited, patients should be asked to confirm whether this pain is upper or lower before they release the pressure from the applicator. Patients should next be asked to grind from side to side on the applicator to determine whether lateral movements invoke a painful response. Following release of biting pressure on the applicator, patients should be questioned as to whether there was any pain upon release of the applicator. This is important in the detection of cracked teeth, which will be discussed later in the article. These bite tests help isolate the offending tooth if a patient is complaining of biting pain, and assist in the peri-radicular diagnosis of the tooth.

Figure 6. Bite stick test



This test is conducted to confirm the presence or absence of symptoms to biting pressure or chewing. The patient is asked to close on a cotton-tipped applicator that is placed between the occlusal surfaces of two opposing teeth. The presence or absence of a painful response is determined for each tooth that is tested.

Percussion Test

Percussion is another test used to isolate the causative tooth and helps in determining the peri-radicular diagnosis. This test is typically performed using the metal handle end of an intra-oral mirror, and the tooth is gently tapped a few times from the occlusal and then the buccal surface. The intensity should be minimal but repeated consecutively, with each tapping motion becoming slightly more pronounced. A painful response confirms the presence of peri-radicular inflammation, and the intensity of the discomfort can be compared with other teeth by the increase in severity of the symptoms when the tooth is repeatedly percussed as described. It is not unusual for teeth adjacent to the symptomatic tooth to be sensitive also, but this is unlikely to increase in intensity in a manner similar to the problematic tooth and can usually be distinguished from the causative pain based on the non-progression in intensity of the pain response with repeated gentle tapping. If the discomfort does not progress

with repeated percussion, this would be termed a sensitive tooth that should be re-evaluated at the next appointment to determine if these symptoms have dissipated, since the acute symptoms from the tooth that was treated should have resolved by then.

Pulp Vitality Tests

The next series of tests are collectively termed pulp vitality tests and are performed in order to determine the pulpal status. These tests are important, as there has to be irreversible pulpal inflammation present for peri-radicular inflammation to be initiated by endodontic etiology. Thermal testing is the most accurate method of testing pulp vitality and is carried out to stimulate A-delta fibers in the pulp. These fibers are some of the most resistant to degeneration, and the absence of sensations during testing is a true indicator of irreversible pulp damage, which is the precursor to pulp necrosis.

Cold Testing

Cold testing causes contraction of dentinal fluid within the tubules, with a subsequent rapid outflow of fluid in the tubules that stimulates mechanoreceptors in the pulp-dentin complex, resulting in a sharp instantaneous response. In a tooth with a healthy pulp, this will typically fade within a few seconds of the stimulus being removed. When the pulp has become irreversibly inflamed, the cold stimulus will usually initiate a lingering, exaggerated response for seconds, if not minutes, after the cold stimulus has been removed. This may radiate to the adjacent teeth or those in the opposite arch. The other non-normal response is the lack of a reaction to cold despite testing on both buccal and lingual surfaces of the tooth. Testing is carried out using a variety of cold materials, each with varying degrees of coldness. The material used is selected based on the patient's chief complaint. If he or she is complaining of pain from cold even when breathing in cold air, then it is inhumane to use an Endo Ice spray that will send his or her pain levels soaring. It is more appropriate to use cold air from the air/water syringe to directly spray air to the buccal gingival margin of each tooth individually, while the other teeth are completely shielded using dry gauze (Figure 7). The cold air may not be sufficiently cold to evoke responses in all teeth that have healthy pulps, but the offending tooth should be easily detected using this method. This method has numerous limitations and should be used only when a patient cannot tolerate anything that is remotely cold in his or her mouth.

Patients who provide information that cold drinks or ice stimulates their pain should be tested using ice pencils. These can be made at little or no cost by freezing water in local anesthetic needle sheaths that have not been contaminated. One end is covered with gauze to provide a handle while the exposed end is applied to the tooth. A lingering response to

cold, or acute pain to cold that is exaggerated compared to the pain of the surrounding teeth and similar to the patient's symptoms when he or she drinks, is a good indicator that the causative tooth has been localized. It is important that the other teeth remain isolated, to prevent the ice pencil from melting and water contacting the adjacent teeth. This test has significant limitations, as the pencil can melt and contact the adjacent teeth, or water can drip down from the pencil when testing upper teeth and contact the lower teeth.

Figure 7. Application of a fine air spray of cold air from a Stropko Irrigator



The fine air spray is directed toward the buccal gingival margin of the tooth to be tested and in the direction of the region already tested. Teeth #6 and #7 have already been tested, and the teeth posterior to tooth #5 are well shielded from the air spray by the tight adaptation of dental gauze (2"x2") to the posterior teeth.

Patients who complain of intermittent pain, constant pain or pain that is indiscriminate, without definitive painful responses to cold, are tested using very cold substances such as 1,1,1,2-tetrafluoroethane (e.g., Endo Ice, Hygienic, Akron, OH) (Figure 8).

Figure 8a. Endo Ice canister



This has a temperature of -37°F and can even evoke responses from the pulp underneath porcelain fused to metal crowns and gold crowns. This should be the primary mode of cold testing during the diagnostic phase of treatment, when the situations described above are not present. The solution is sprayed onto a cotton pellet until it is saturated. This is then applied to the buccal surface of the tooth at least 3-4 mm above the gingival margin. The pellet is held to the tooth for 5-10 seconds or until the patient obtains a response (Figure 8c).

Figure 8b. Cotton pellet immediately after saturation with Endo Ice



Figure 8c. Application of the #3 cotton pellet saturated with Endo Ice



This is applied to the buccal surface of tooth #28, away from tooth #27 or tooth #29, maintained in contact with the tooth for 10-15 seconds, and the presence or absence of a response confirmed.

The absence of a response to cold testing by this method, when correctly performed, is a likely indicator of pulp necrosis. A second test should be used to confirm this diagnosis. It should be determined whether this response is lingering, delayed, more intense, less intense or similar to the other teeth that have been tested. Whenever there are lingering or acute symptoms with cold testing, a diagnosis of irreversible pulpitis is made. It has been determined from controlled clinical trials that it is not necessary to place the patient on antibiotics such as penicillin, as this will not improve their symptoms.¹⁸ It is more beneficial to remove the diseased pulp from the tooth as expediently as possible.

Heat Testing

The application of heat is usually reserved for cases where the patient states that he or she is experiencing pain with warm substances. The pain in these situations is usually intense and lingers for a period of time following the intake of the warm substance and its stimulation of the offending tooth. It is not unusual for patients with severe discomfort to be constantly bathing the tooth in cold water to prevent the pain from escalating.

The application of heat causes expansion of the gases created by necrosis to invoke significant pain. Pain with heat is typically an indicator of partial pulp necrosis and the initiation of a pulpal infection in the tooth. When patients are experiencing pain with heat, this test should be used as one of the final tests, after other testing has been performed and additional information has been obtained. Even if prior testing provides a definite diagnosis as to the affected tooth, the heat test should still be performed to reassure the patient and the treating doctor that the etiology will definitely be managed by endodontic treatment. Application of heat stimulates a response in the pulp by causing expansion of the fluid inside the dentinal tubules. This movement will again trigger the A-delta fibers located around the tubules. Once the symptoms have been reproduced, cold can be quickly reapplied to the tooth using Endo Ice spray or applying an ice pencil to the buccal surface, and this should again relieve the patient's discomfort. It is possible, especially in patients with restorations in numerous teeth, that there may be more than one tooth with potential endodontic involvement. However, it is important to remain focused on the tooth that is creating the chief complaint for the patient, whose expectation is that the symptoms will be resolved by the endodontic treatment he or she is about to undergo.

Electric Pulp Test

The final test that is used for pulpal diagnosis is the electric pulp test (Figure 9). This test will stimulate the A-delta fibers that are also stimulated by thermal testing. A metal hook or clip is placed on the patient's lip, and a probe tip covered in a conducting medium such as toothpaste is applied to the middle third of the tooth surface. Whenever possible, the probe should not contact the surface of a restoration. A pulsating electric stimulus is created, beginning at a very low value and gradually increasing in intensity. When patients experience a pulsing, tingling or vibrating sensation, they are instructed to indicate their response to the stimulus. The probe is then removed and the next tooth tested. It is prudent to test an adjacent or contralateral tooth before the suspected tooth so that the patient has some awareness of the responses he or she is supposed to feel. This test will confirm the presence of vital pulp tissue but should be used only as an adjunct for pulpal diagnosis. This is because there is a risk of false positive responses where the A-delta fibers have become non-vital but there is still a positive response from the tooth. This can occur from the periodontal tissues, from inadequately dried teeth and from contact with metallic restorations. In conjunction with the pulp testing performed, it is also important to establish etiology for the symptoms and pulpal responses. It is straightforward to establish this in cases where there are large cavities or restorations in close proximity to the pulp, or where crown preparation work has been recently performed, but there appears to be a greater incidence of cracked teeth, which could also be the etiology for a patient's symptoms.

Figure 9. Application of the electric pulp tester to the mid-buccal surface of tooth #8 for vitality testing



The patient is holding the sensor as the operator is wearing gloves (as recommended), and there is a conducting medium (toothpaste) on the tip of the sensor to provide good electrical contact.

Cavity Test

“Cavity test” refers to access, without anesthesia, to a cavity preparation in a tooth that is suspected to be necrotic. This is rarely necessary when all other tests are performed, and it should be reserved only for very unusual situations.

Cracked Teeth

Cracked teeth complicate diagnosis, as the symptoms are often vague, intermittent, and difficult to isolate or reproduce. Bite tests may elicit the pain that the patient is experiencing, but the pulp can rapidly become non-vital when the tooth has cracked and the cracks have entered the pulp chamber. This can result in the rapid loss of symptoms, thereby making the offending tooth difficult to diagnose until further symptoms or pathology manifest. To understand the testing required when determining the presence of a cracked tooth, it is first necessary to differentiate between the different types of cracks that may be present in the tooth.

Cracked Cusps

The first potentially symptomatic situation is the presence of a cracked cusp, where the cusp on a posterior tooth is cracked at the base on the pulp chamber floor. This may or may not produce pulpal symptoms such as temperature sensitivity, but there should be biting discomfort when pressure is applied to the affected cusp. Testing should also be carried out on the other cusps to confirm that it is just a cracked cusp situation and that the tooth as a whole has not cracked. When there is a suspicion of a cracked cusp, the existing restoration should be removed and methylene blue applied to the pulp chamber floor and the potentially affected cusp. The methylene blue should then be rinsed away within 10-15 seconds, but it will remain in the crack and be easily identifiable using magnification (Figure 10).

Application of firm outward pressure to the cusp from the internal aspect of the cavity often results in the cusp

becoming dislodged from the tooth at its base. If the pulp is not exposed by loss of the cracked cusp, a restoration may then be placed, with no need for endodontic treatment, unless the tooth becomes pulpally symptomatic following crown preparation and temporary restoration placement.

Figure 10. Examination of tooth using dental microscope (Zeiss OPMI pico, Zeiss Meditec, Dublin, CA) for 16x magnification

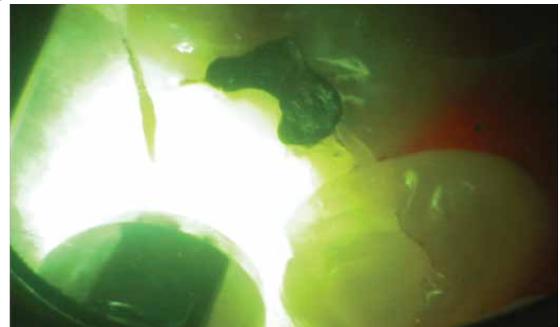


Existing filling removed and methylene blue used to stain internal surfaces of occlusal cavity. Staining reveals a crack on mesial marginal ridge and a horizontal crack on buccal wall, extending mesial to distal.

Cracks on the Pulp Chamber Floor

The second potentially symptomatic cracked tooth situation is when the crack has extended from the mesial and/or distal walls onto the pulp chamber roof. A crack on the pulp chamber roof will likely induce pain with pressure that is characterized by a sharp pain on release of pressure when biting. As in cracked cusp situations, pulpal symptoms may or may not be present. Symptoms to pressure may be difficult to elicit unless the cracked area is compressed. Once symptoms have been identified, a transillumination device can be used to confirm the presence of cracks underneath any restorations that may be present and to determine the extent and depth of the cracks. This is usually confirmed by shining a bright light on the buccal or lingual surface of the tooth. For a tooth that is not cracked, the light will shine through to the opposite surface without any interruption.

Figure 11. Use of a transillumination device



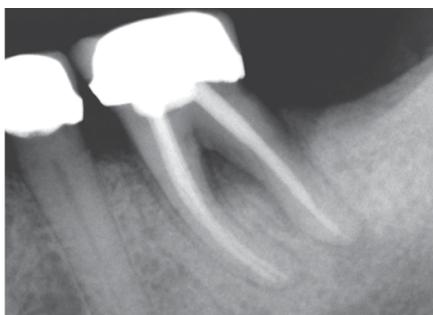
Cracks were detected on the occlusal surface during the examination. The mesial buccal cusp is fractured, as the light does not extend through this cusp toward the distal or lingual surface. An additional crack line can also be seen on the mesial marginal ridge.

The presence of a crack underneath the occlusal surface will inhibit the passage of light through the tooth (Figure 11). This provides additional confirmation that the tooth has indeed cracked and interventional treatment is necessary. The most commonly cracked teeth are mandibular molars and then maxillary premolars, followed by maxillary molars.^{19,20}

Periodontal Examination

The decision to treat a cracked tooth or any endodontically involved tooth should not take place without a thorough periodontal examination to determine the status of the supporting tissues. Six measurements are taken for periodontal pocket depths around the tooth. This is important, as the presence of deep periodontal pocketing adjacent to a root surface can be indicative of a vertical root fracture that is progressing apically and simultaneously compromising the periodontal attachment. The pocket in these instances is typically narrow and affects only one probing location unless the problem has been long standing and has caused more widespread periodontal destruction. It is always helpful to place a small gutta-percha (GP) cone in the pocket and trace the pocket depth radiographically (Figure 12).

Figure 12a. Tooth #19 is tilted mesially and has an existing RCT and crown that radiographically appear technically satisfactory



There is a radiolucency in the furcation and at the distal alveolar crest on the distal surface of the distal root. There is a small peri-radicular radiolucency limited to the distal root apex, but there is circumferential thickening of the periodontal ligament space around the distal root.

Figure 12b. Radiographic periodontal pocket confirmation



Mid-buccal and distal buccal 9-10 mm pockets traced using GP points to confirm pocket depth and location.

This will provide a visual representation of the depth of the pocket and may also assist with determining the etiology. If the GP cone traces to the coronal or mid-root region of the root and there is no associated periapical radiolucency, it is likely that the etiology is a root fracture. When the tooth is responding positively to pulp vitality testing, the periodontal pocket is unrelated to the pulpal status, as a positively responding pulp cannot have an infection that is significant enough to stimulate a periodontal infection. In these instances it is more likely that the etiology is periodontal or fracture related. A referral to a periodontist for further evaluation may be necessary before the etiology can be confirmed and a definitive treatment plan formulated. Periodontal pocket formation can also be from the development of pulpal non-vitality, secondary to an internal crack and the subsequent establishment of a drainage path through the periodontal support.

When a deep periodontal pocket is associated with a non-vital tooth, there is the likelihood that the periodontal pocket will resolve once endodontic treatment is performed. The pocket should again be traced prior to treatment using a small GP cone to provide a record of the pocket depth. Endodontic treatment should then be initiated, and the absence of fractures extending into the root canals or across the pulp chamber floor should be confirmed visually, ideally under magnification.

The pocket depth should be re-evaluated once sufficient time has elapsed for periodontal healing, which is typically 6-8 weeks.²¹ Confirmation of a primary endodontic problem with secondary periodontal breakdown is confirmed by periodontal pocket resolution. Should the pocket persist, referral to a periodontist would be necessary for possible pocket debridement or exploratory flap surgery to determine the etiology for non-healing.

Sinus Tracts

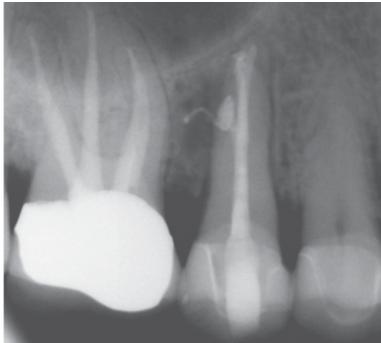
The development of a sinus tract is similar to the establishment of a periodontal pocket, with the difference that the sinus tract can appear on any part of the surrounding soft tissues. A sinus tract can occur irrespective of the presence of a crack and is defined as the formation of an opening on the soft-tissue surface for the body to establish drainage of infection. For it to be of endodontic origin, the pulp must be non-vital, and usually there is an associated peri-radicular radiolucency radiographically. These tracts should always be traced to determine the origin of the infection. Not only does this provide definitive confirmation as to the causative tooth, it will also help to determine the presence of unusual anatomy. It is not uncommon to see a sinus tract tracing to the lateral aspect of the tooth when there is a large lateral canal present (Figure 13).

Figure 13a. Diagnostic tracing of a sinus tract



Tracing using a GP cone to the distal surface of tooth #4, which presents radiographically with a lateral, not a peri-radicular, radiolucency.

Figure 13b. Immediate post-operative radiograph



Note the radio-opaque filling material within a large lateral canal adjacent to the lateral radiolucency.

Figure 13c. One-month recall radiograph



Note the almost complete resolution of the existing lateral mid-root radiolucency following endodontic treatment.

Summary

Compilation of the information obtained from the results of all tests enables accurate endodontic diagnosis and formulation of a treatment plan. As a result of this comprehensive testing, the offending tooth should have been identified and a pulpal diagnosis made. The diagnosis determines the treatment planning for the procedure to be performed, especially when considering the extent of emergency treatment to be provided, and will aid the formulation of a definitive treatment plan that is in the best interest of the patient and the clinician.

References

- 1 American Association of Endodontists: Endodontic fact sheet – endodontics and endodontists. 2005. Available at www.rootcanalspecialists.org.
- 2 Sahlerabi R, Rotsein I. Endodontic treatment outcomes in a large patient population in the USA: an epidemiological study. *J Endod.* 2004;30(12):846-50.
- 3 Bergenholtz G, Lindhe J. Effect of experimentally induced marginal periodontitis and periodontal scaling on the dental pulp. *J Clin Periodontol.* 1978;5:59.
- 4 Schüpbach P, Lutz F, et al. Closing of dentin tubules by Gluma desensitizer. *Eur J Oral Sci.* 1997;105:414.
- 5 Pashley DH. Potential treatment modalities for dentin hypersensitivity in office products. *Tooth Wear and Sensitivity.* 2000, Martin-Dunitz, 351.
- 6 Brannstrom M, Lind PO. Pulpal response to early dental caries. *J Dent Res.* 1965;44:1045.
- 7 Abou Rass M, The stressed pulp condition: An endodontic-restorative diagnostic concept. *J Pros Dent.* 1982;48:264-67.
- 8 Lee SJ, Walton RE, Osborne JW. Pulp response to bases and cavity depths. *Am J Dent* 1992;5(2): 64-8.
- 9 Cheung GS, Lai SC, Ng RP. Fate of vital pulps beneath a metal-ceramic crown or a bridge retainer. *Int Endod J.* 2005;38:521-30.
- 10 Felton D. Long-term effects of crown preparation on pulp vitality. *J Dent Res.* 1989;68:1009.
- 11 Barthel CB et al. Pulp capping of carious exposures: treatment outcome after 5 and 10 years: a retrospective study. *J Endod.* 2000;26(9):525-28.
- 12 Pameijer CH, Stanley HR. The disastrous effects of the “total etch” technique in vital pulp capping in primates. *Am J Dent.* 1998;11:S45 [published erratum appears in *Am J Dent.* 1998;11(3):148].
- 13 Stanley HR, Swerdlow H. An approach to biologic variation in human pulp studies. *J Prosthet Dent.* 1964;14:365.
- 14 Hume WR, Gerzia TM. Bioavailability of components of resin-based materials which are applied to teeth. *Crit Rev Oral Biol Med.* 1996;7:172.
- 15 Bouillaguet S. Biological risks of resin-based materials to the dentin-pulp complex. *Crit Rev Oral Biol Med.* 2004;15:47.
- 16 Murray PE, About I, et al. Restorative Pulpal and Repair Responses. *J Am Dent Assoc.* 2001;132: 482- 90.
- 17 Baumgartner JC, et al. Microscopic examination of oral sinus tracts and their associated periapical lesions. *J Endod.* 1984;10(4):146.
- 18 Nagle D, Reader A, Beck M, Weaver J. Effect of systemic penicillin on pain in untreated irreversible pulpitis. *Oral Surg Oral Med Oral Pathol.* 2000;90:636.
- 19 Cameron CE. The cracked tooth syndrome: additional findings. *J Am Dent Assoc.* 1976;93:971-75.
- 20 Homewood CI. Cracked tooth syndrome: incidence, clinical findings and treatment. *Aust Dent J.* 1998;43:217-22.
- 21 Scheyer ET. Personal communication on healing of periodontal pocket from a primary endodontic etiology, following endodontic treatment. 2009.

Author Profile

Manish Garala BDS, MS, Diplomate, American Board of Endodontics is in specialist endodontic practice in Houston, and also adjunct faculty in the department of Endodontics at UTDB Houston. He can be reached by email at mng@ceendo.com.

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Questions

- The same protocol of examination and testing should be employed in each instance in order to obtain the most precise response and establish _____.
 - a differential diagnosis
 - a tentative diagnosis
 - the most accurate diagnosis
 - none of the above
- An examination should always be initiated by _____.
 - obtaining the patient's chief complaint
 - obtaining all of the patient's complaints
 - pulp testing
 - none of the above
- Reversible pulpitis _____.
 - can be related to recent scaling and root planing procedures
 - results in pain that is immediate but also relieved without intervention within a few seconds
 - requires no endodontic treatment at the time
 - all of the above
- Any form of tooth reduction by caries formation, caries removal or mechanical preparation _____.
 - always results in the formation of secondary dentin
 - results in abfraction
 - causes injury to the pulp
 - none of the above
- The pulp's capacity to repair _____.
 - depends on the extent of the injury
 - is dependent on the presence of an adequate microcirculation within the pulp tissue and the absence of extensive pulpal calcifications
 - is greater in younger patients than in older adult patients
 - all of the above
- In the case of a mechanical pulp exposure _____.
 - there tends to be limited existing pulpal inflammation prior to the exposure
 - tertiary dentin has not been laid down
 - the exposure usually occurs in an environment that is relatively free of bacteria
 - all of the above
- Pulpal responses, as a result of procedures, can be minimized by _____.
 - adequate water spray
 - coolant
 - high-speed instruments
 - all of the above
- Irrespective of the dental history or the chief complaint, it is absolutely essential that _____ be performed before the decision is made to initiate endodontic treatment.
 - pulp testing
 - bite testing
 - periodontal testing
 - none of the above
- Pulp testing should be carried out in an organized, systematic manner, enabling information that is obtained _____.
 - to be verified digitally
 - to be programmed
 - to be compared with that of the different teeth that are being tested
 - none of the above
- The first test to be undertaken should be the test that _____ for triggering his or her presenting symptoms.
 - the clinician feels is responsible
 - the patient feels is responsible
 - the radiograph indicates is responsible
 - all of the above
- Palpation tests are performed _____.
 - using firm pressure from an index finger on the buccal and lingual mucosa in the area of the root apex of each tooth to be tested
 - using firm pressure from an index finger on the gingival margin of each tooth to be tested
 - to help identify whether there is swelling present at the apex of these teeth or if there is severe apical inflammation
 - all of the above
- Identification of sinus tracts should be performed at the time of _____.
 - the bite test
 - palpation testing
 - periodontal examination
 - all of the above
- A mobility test is performed to determine _____.
 - tooth vitality
 - tooth stability
 - the patient's level of pain
 - all of the above
- Grade 2 or 3 mobility could be the result of _____.
 - trauma or root fractures
 - rapid orthodontic movement
 - periodontal disease
 - all of the above
- Bite tests _____.
 - are important for the detection of cracked teeth
 - are typically performed using a cotton-tipped applicator
 - help isolate the offending tooth if a patient is complaining of biting pain
 - all of the above
- A percussion test _____.
 - is used to isolate the causative tooth
 - is typically performed using the metal handle end of an intra-oral mirror, and the tooth is gently tapped a few times from the occlusal and then the buccal surface
 - helps in determining the peri-radicular diagnosis
 - all of the above
- It is not unusual for teeth adjacent to the symptomatic tooth _____ to percussion testing.
 - to be sensitive
 - to be insensitive
 - to be resistant
 - none of the above
- There has to be _____ pulpal inflammation present for peri-radicular inflammation to be initiated by endodontic etiology.
 - reversible
 - irreversible
 - palpable
 - none of the above
- When the pulp has become irreversibly inflamed, _____.
 - the cold stimulus will usually initiate a lingering, exaggerated response for seconds, if not minutes, after the cold stimulus has been removed
 - pain may radiate to the adjacent teeth
 - the response (pain) may radiate to the teeth in the opposite arch
 - all of the above
- Patients who complain of intermittent or constant pain, or pain that is indiscriminate, without definitive painful responses to cold, are tested using _____ substances.
 - lukewarm
 - very hot
 - very cold
 - all of the above
- The absence of a response to cold testing, when correctly performed, _____.
 - is a likely indicator of pulp necrosis
 - should be followed by a second test to confirm this diagnosis
 - is a likely indicator of pulpal health
 - a and b
- Pain with heat is typically an indicator of _____.
 - complete pulp necrosis
 - partial pulp necrosis
 - periodontal disease
 - none of the above
- The final test that is used for pulpal diagnosis is the _____.
 - mobility test
 - palpation test
 - electric pulp test
 - periodontal test
- It is prudent when performing electric pulp tests to _____.
 - test an adjacent tooth before the suspected tooth
 - test a contralateral tooth before the suspected tooth
 - ignore adjacent teeth
 - a or b
- Electric pulp testing _____.
 - will confirm the presence of vital pulp tissue
 - should be used only as an adjunct for pulpal diagnosis
 - stimulates the A-delta fibers
 - all of the above
- A cracked cusp on a posterior tooth that is cracked at the base on the pulp chamber floor _____.
 - may or may not produce pulpal symptoms such as temperature sensitivity
 - always produces pulpal symptoms such as temperature sensitivity
 - should be associated with biting discomfort when pressure is applied to the affected cusp
 - a or b
- Methylene blue is used to confirm the presence of _____.
 - dental caries
 - a cracked cusp
 - periodontal disease
 - all of the above
- The most commonly cracked teeth are _____.
 - mandibular molars
 - maxillary molars
 - maxillary premolars
 - none of the above
- Periodontal pocketing adjacent to a root surface _____.
 - can be indicative of a vertical root fracture
 - can result from the development of pulpal non-vitality, secondary to an internal crack
 - will resolve following successful endodontic treatment if related to a primary endodontic problem and the periodontal breakdown was secondary to this
 - all of the above
- Comprehensive testing during endodontic diagnosis aids in formulating a _____ that is in the best interest of the patient.
 - tentative treatment plan
 - definitive treatment plan
 - three-stage treatment plan
 - none of the above

Contemporary Endodontic Evaluation and Diagnosis: Implications for Evidence-Based Endodontic Care

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- List and describe the considerations in determining a patient's chief complaint and the importance of obtaining an accurate dental history
- List and describe the implications of pulpal exposure and the success rates of direct pulp therapy
- List and describe the tests that should be performed to assess the status of the pulpal and periradicular health
- List and describe the types of cracked teeth, testing that can be performed and the implications for treatment

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