When Patients Run Hot and Cold: Guidelines for Endodontic Diagnosis

Endodontic diagnosis often presents challenges for the practitioner. Consider the following scenarios:

- A patient named Barbara comes into your office and tells you the following story: "I've been experiencing pain every time I put something cold in my mouth. It seems to be getting worse. Last night, I tried to drink iced tea, and the pain was really severe."

Barbara, Joe, and John present endodontic diagnostic challenges, and they want immediate relief. The task at hand is to determine the involved tooth and cause of the pain and then to render appropriate treatment.

- Another patient, Joe, enters the office carrying a cup of ice water and reports the opposite problem: "I have a terrible toothache. For the last few days, it hurt whenever I ate or drank something hot. Last night, I tried to eat hot soup, and the pain was worse than it has ever been. That's why I'm carrying this cup of ice water. If I sip ice water every few minutes, I get relief. But as soon as I stop drinking the ice water, the toothache comes right back."

This issue of ENDODONTICS: Colleagues for Excellence emphasizes a systematic approach to endodontic diagnosis. The information presented here will provide insight into how to reach a diagnosis when the patient's chief complaint is pain to a thermal stimulus or chewing pressure and how controlled exposure to a thermal stimulus in the dental office can help the practitioner isolate the source of orofacial pain.

Guidelines for Endodontic Diagnosis

Most orofacial pain is of pulpal or periradicular origin, and pain to thermal stimulus is often an indication of an endodontic problem. The following system is recommended for diagnosis and treatment planning:

Ascertaining the Chief Complaint. Significant pulpal and periradicular pathosis is often asymptomatic, but, when the patient does report a specific complaint, you have your first clue in discovering the location and etiology of the problem.

Take a Detailed Medical and Dental History. The periodontium, jaws, sinuses, ears, temporomandibular joints, masticatory musculature, nose, eyes, blood vessels, and other structures may induce pain that mimics pulpal pain. Other pathologic conditions—such as neuralgia, multiple sclerosis, myocardial ischemia, and psychiatric disorders—may also produce symptoms that are confused with tooth pain. To avoid misdiagnosis and to rule out orofacial pain that is not of endodontic origin, the clinician should identify and document all signs and symptoms.

Conduct All Necessary Objective and Subjective Examinations. These include observation, pulp testing, and radiographic examinations. The clinician should also elicit from the patient the history of the present illness and ask the patient to identify the involved tooth, if the patient is able to do so.

Analyze the Data. While one piece of the puzzle may not lead to a correct diagnosis, an analysis of all the data considered as a whole will usually present a clearer picture of the problem.

Formulate an Appropriate Diagnosis and Treatment Plan. It is obviously critical to treat the correct tooth and to decide whether endodontic treatment needs to be performed immediately or can be scheduled at a later date without adverse consequences to the patient.

The following case studies demonstrate how applying this system helps the dentist reach the correct diagnosis.
Barbara Complains of Pain to Cold

Barbara, the woman who experienced severe pain when sipping iced tea, was examined by Dr. A. Her medical history showed no contributing factors. Current signs and symptoms also showed no contributing factors. Upon examination, Dr. A found no caries, tooth fractures, or other pathosis. The patient seemed to have a dentition in good repair.

Barbara’s complaint of pain to thermal stimulation led Dr. A to suspect an inflamed or degenerating vital pulp. Her dental history and the radiographic examination revealed several long-standing, moderately deep restorations in her posterior teeth (Fig. 1).

Although radiographs are a valuable tool in endodontic diagnosis, the clinician should keep in mind the following diagnostic limitations of radiographs:

- When the pulp is vital, a radiograph is unlikely to show the cause of the pain.
- While radiographs may give a hint—such as large restorations or caries not evident in the clinical exam—there will probably be no “smoking gun” (periapical lesion) on the film.

- As a general rule, then, radiographs are unlikely to pinpoint the etiology of pain elicited by temperature extremes.

Recognizing the limitations of radiographs, Dr. A chose pulp tests based on Barbara’s chief complaint—pain to cold. He reasoned that a cold test would determine the offending tooth. He also chose a percussion test to indicate or rule out acute apical periodontitis, which is often associated with irreversible pulpitis. He used an ice stick to perform the cold test and tested healthy control teeth first.

In testing for pain to cold, Dr. A has found that patients can suspect the wrong tooth. Using controls helped Barbara learn what to expect from the stimulus and gave Dr. A an idea of the nature of the her normal response, because many patients feel moderate pain to cold in all teeth. Dr. A’s goal in cold testing was to find the tooth that was different and to reproduce the complaint.

In Barbara’s case, Dr. A found severe, lingering pain to cold from tooth #30, which was consistent with her complaint, with no other significant findings. Dr. A did not use an electric pulp tester, because a response to cold had already established pulp vitality. The patient had no pain to pressure, no recent dental work, no gingival recession, and no caries. Dr. A diagnosed irreversible pulpitis of tooth #30. He recommended root canal treatment and a full-cuspal coverage restoration. Antibiotic therapy was not indicated, because the pulp was vital.

If Dr. A had relied solely on the radiograph and elected to watch rather than treat the problem, then Barbara might have experienced the preliminary symptoms of irreversible pulpitis over many months. Barbara probably would have learned to deal with this by protecting the tooth from temperature extremes. Over time, however, as the inflammation spread and ultimately led to infection, the symptoms would have progressed to include pressure sensitivity, spontaneous pain, and finally continuous pain.

Dr. A followed a system, came to the correct diagnosis, and saved this patient from unnecessary suffering and inconvenience.

Joe Complains of Pain to Heat

Joe, the patient who walked into the dental office carrying a cup of ice water and complaining of pain to heat, was examined by Dr. B.

When asked to locate the source of the pain, Joe was unsure. He knew it was on the left side of his mouth, but he could not be certain whether it was from an upper or lower tooth. Joe had noticed no other signs or symptoms at this point, saying that he had experienced this severe toothache over the last few days whenever he ate or drank something hot.

A review of the patient’s record showed that two teeth—#18 and #19—had deep restorations placed during the past two years. Generalized pulp calcification was evident on previous radiographs. Upon further questioning, the patient remembered having had pain to cold temperatures for months after the restorations were placed.

“I didn’t bother to come back right away,” Joe said, “and it must have gotten better with time, or I just got used to it.”

A new radiograph (Fig. 2) showed thickening of the PDL of the mesial root of tooth #18. However, both #18

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and #19 were sensitive to percussion. Dr. B explained to Joe that she needed to use a
thermal test to determine for certain which
tooth was the culprit. “Because higher
temperatures are making your tooth hurt, I could apply heat to
one tooth at a time to reproduce the pain. When the pain starts
again, we will know which tooth is the culprit. However, I think
the test will be more comfortable for you if I perform it in
reverse. If you stop sipping the ice water for a while and let me
know when the pain returns, I can cool one tooth at time with an
ice stick until the pain stops.”

Joe immediately understood why this was necessary. “I don’t
want you working on the wrong tooth,” he said and stopped
sipping the ice water. In a short time the pain returned. Dr. B
began by cooling #19 with the ice stick. When this gave no relief,
she placed ice on #18, and in just a few seconds the pain began
to diminish. This confirmed her suspicion of irreversible pulpitis
and acute apical periodontitis of tooth #18. Because lower molars
are particularly difficult to anesthetize and generalized pulp
calcification was evident on the radiograph Dr. B elected to refer
Joe to an endodontist for root canal treatment.

If Dr. B had not performed thermal testing, she would have been
unable to locate the source of the pain, and the pathosis would
likely have progressed within a few days to a necrotic pulp.
However, by following systematic diagnostic procedures, Dr. B
was able to achieve an accurate diagnosis, and take action to
ensure immediate relief.

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**Case #3**

**John Complains of Intermittent Spontaneous Pain**

John, the patient reporting an intermittent spontaneous toothache, was examined by
Dr. C. Several days before his appointment,
John noticed increasing pain when chewing in
the area of teeth #5 and #6.

John’s medical history showed no
contributing factors, and he reported no
other signs or symptoms. Tooth #5 was
the mesial abutment for a three-unit
bridge. Tooth #6 had a small distal
amalgam restoration. Dr. C found #5 and
#6 were equally painful to percussion. On
palpation, she noted tenderness and a
slight
periapical
swelling in
the region of
#5 and #6.

Dr. C suspected
that the
pathosis
would be
located in
tooth #5,
because that tooth had a full coverage
restoration, while tooth #6 had only a
small amalgam restoration. A radiograph
seemed to confirm her suspicion, showing
a periapical lesion associated with
tooth #5 (Fig. 3). Recognizing
the limitations of radiographs,
however, she used a cold test to
confirm her diagnosis.

In testing tooth #5, Dr. C first
tried to apply ice to the metal
collar or exposed tooth struct-
ure, but this was not possible.
She then applied ice near the
gingival margin, testing a
control tooth first so that John could
differentiate between a response coming
from the gingiva and a response coming
from the tooth. Tooth #5 had a mild,
normal response to ice, while #6 was
unresponsive. Perplexed, she performed
an electric pulp test on #6.

(He did not perform
an electric pulp test
on #5, because it is
not possible to do an
effective electric pulp
test on a tooth with a
crown, and the
response to cold had
already indicated
pulp vitality.) Again,
tooth #6 was
unresponsive. Based
on these results, Dr.
C began to suspect that the pathosis was
located not in tooth #5, as she had
originally suspected, but in tooth #6. She
took a second radiograph from a different
angle, which confirmed that the pathosis
was actually centered around tooth #6
(Fig. 4). She diagnosed pulpal necrosis
with acute
periapical
abscess of #6
and
recommended
endodontic
treatment
and
appropriate
restoration.

This case
demon-
strates the
importance
of using not
only
radiographs
but also
confirmatory pulp tests to reach a correct
diagnosis. Dr. C’s diligence in following a
proper endodontic diagnostic protocol—
including pulp testing—led to a correct
diagnosis and an acceptable outcome.

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**The goal in pulp
testing is to find the
tooth that is different
and to reproduce the
complaint.**
The three case studies presented demonstrate a few common diagnostic dilemmas encountered daily in dental offices. Each case presents a patient with different complaints and symptoms. What each case shares is the need for the dentist to use his/her knowledge and critical thinking skills to gather and sort through all available information to determine the correct diagnosis. This newsletter includes a summary outline of the endodontic diagnosis system as an insert.

Each evaluation begins with an interview of the patient to ascertain the chief complaint. An updated medical and dental history is reviewed, as well as all current signs and symptoms.

Next, clinical information must be collected through subjective, objective, and radiographic examinations. Pulp testing is intended to reproduce the patient's chief complaint in the controlled environment of the dental operatory. Tests should recreate, individually for each tooth, the stimulus that elicits pain.

The clinician must keep in mind that thermal pain is caused by vital pulp tissue and use appropriate tests to determine the source. Swelling or drainage of infection are byproducts of pulpal necrosis. Pain to pressure and spontaneous toothache can be the result of either vital or nonvital pulp pathosis. Critical thinking is necessary to determine what information should be gathered in the investigative phase of diagnosis.

Once the appropriate data have been collected and analyzed, the preliminary diagnosis should be reviewed to be certain it fits with all the signs and symptoms. Confirmatory tests help prevent misdiagnosis and inappropriate treatment. Not all orofacial pain is of endodontic origin. If the data gathered do not support your conclusion, consider referral to an appropriate dental or medical specialist. Endodontists can be a valuable resource because of their special training and experience in diagnosing and treating difficult and unusual cases.

Regardless of technical excellence, a root canal procedure performed on the wrong tooth is always a failure!

While there is no guarantee of success in every case, the American Association of Endodontists hopes this issue of ENDOdontics: Colleagues for Excellence will aid in achieving accurate diagnosis of endodontic pathosis. Practitioners must always use their best professional judgment in individual situations. The AAE neither expressly nor implicitly warrants any positive results nor expressly nor implicitly warrants against any negative results associated with the application of this information.

If you would like more information on endodontic diagnostic considerations, call your local endodontist or write to the American Association of Endodontists, 211 E. Chicago Ave., Ste. 1100, Chicago, IL 60611-2691, 312/266-7255, fax 312/266-9867. References are available upon request.

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**Enhanced vision helping endodontists see inside the root canal system**

Root canal treatment has been described as the art of treating the smallest of tissues in the most difficult of locations. Patients are often amazed when they have the opportunity to see the tiny, remote spaces in which general dentists and endodontists routinely work.

Endodontists have long been leaders in the use of enhanced illumination and magnification for dentistry. Surgical binoculars, operating headlamps, and fiber optic illumination have been a part of the endodontist's armamentarium for many years.

The surgical operating microscope is on the horizon as an addition to this armamentarium. The first surgical microscopes were introduced in this country in the early 1940s by otolaryngologists, who appreciated the illumination and magnification they could achieve with the microscope.

Endodontists initially used today's modern microscopes for surgery. Many have found that further magnification and illumination of the surgical field can be beneficial to the practitioner.

In addition, the microscope can aid in diagnosis and nonsurgical root canal treatment. The microscope can also assist in locating unusually positioned canal orifices and may be used for added magnification and illumination during retreatments and other challenging procedures.

With the microscope, structures that are barely detectable with the naked eye become easier to see. For example, an isthmus frequently runs between two canals in the mesiobuccal root of the maxillary first molar. These small isthmuses should be included in root-end preparations and root-end fillings. They are more easily located with magnification, allowing them to be prepared with the main canals.

The microscope is also a useful education tool. With built-in video, students and practitioners can observe live procedures. Treatments may also be videotaped for later viewing.

By exploring new methods of illumination and magnification, endodontists continue to advance the leading edge of technology, making those tiny canals seem a little larger and more accessible.

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**Comments?**

Did you enjoy this issue of ENDOdontics? Did the information have a positive impact on your practice? Are there topics you would like ENDOdontics to cover in the future? We want to hear from you! Send your comments, questions, and suggestions to:

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American Association of Endodontists
211 East Chicago Avenue, Suite 1100
Chicago, IL 60611-2691

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Classification/Assessment


Facial Pain
Ingle JI and Bakland LK. *Endodontics*. Chapters 10 & 11 Williams & Wilkins, Baltimore, 1994.


Emergency Treatment


**Radiographic Assessment**


**Operating Microscope**


