

LEARNING OBJECTIVES

After reading this article, the reader should be able to:

- describe a systematic approach to assessing odontogenic pain.
- differentiate odontogenic pain from non-odontogenic pain.
- discuss how to properly triage a patient to the appropriate specialist for the necessary diagnosis and treatment.

A Systematic Approach to Endodontic Diagnosis: A 13-Step Process

Ali Allen Nasseh, DDS, MMSC, PC

ABSTRACT

Dental clinicians regularly encounter diagnostic challenges involving pain in the orofacial region. Although orofacial pain has a variety of causes involving a multitude of organs and structures in the head, face, and mouth, most patients seeking care on an outpatient basis in a dental clinic suffer from the most common cause of odontogenic pain: pulpitis. It is beyond the scope of this article to discuss all of the aspects of orofacial pain beyond odontogenic causes, but the goal is to introduce clinicians to a systematic approach to assess odontogenic pain and differentiate it from non-odontogenic pain. This way, either a restoration, endodontic therapy, or extraction can be performed to relieve pain, or the patient is properly triaged to the appropriate specialist for the necessary diagnosis and treatment.

A 42-year-old woman presents for emergency treatment with a chief complaint of severe pain over the past 2 days in her upper jaw. The patient attributes the pain to tooth No. 3, as it received endodontic therapy 2 years ago (Figure 1). She complains of severe (pain score of 9/10), dull, throbbing pain in the right side of the face, jaws, and cheek that radiates into the temple with episodes of acute sharp pain, which is more severe at night, and appears to be stemming from the maxillary right molar (tooth No. 3). The patient has been awakened with pain over the past couple of nights and takes 600 mg of ibuprofen for relief. The patient also complains of a history of cold sensitivity from that tooth over the past couple of months and a history of low-grade chewing pain ever since the root canal. The past dental history is significant for a recent prophylaxis and fluoride treatment within the past month, and two fillings in the maxillary left side (teeth Nos. 12 and 14), and a crown in tooth No. 30

within the past 3 months (Figure 2). The patient's medical history is insignificant, with no allergies reported. Extraoral tests are insignificant for objective findings. Intraoral tests show that tooth No. 3 is sensitive to percussion (3/10) and the radiograph shows a localized periapical radiolucency associated with the mesiobuccal (MB) root of this tooth.

At this point, a diagnosis of previous endodontic therapy with a failing MB root in tooth No. 3 appears clear. But whether the cause of the patient's chief complaint is this pathology or not requires further investigation. Because the patient complains of severe pain and increasing thermal sensitivity over the past few weeks, testing should be directed toward a diagnosis of a degenerating vital pulp and not a tooth with a history of endodontic treatment. Necrotic teeth or failing endodontically treated teeth do not manifest thermal sensitivity. This is why clinical tests, in combination with an emphasis on duplicating the patient's

chief complaint, are necessary to arrive at the correct diagnosis. After clinical tests are performed, tooth No. 30 is found to have a severe, lingering response to the cold test and is slightly "different" to percussion. This test duplicates the patient's chief complaint. Endodontic therapy in this tooth is performed and pain is relieved (Figure 3). Tooth No. 3, with its apical pathology around the MB root, is later retreated to address a missed second mesiobuccal canal (MB2), relieving the patient from the chewing pain (Figure 4).

ENCOUNTERING ODONTOGENIC PAIN

The case above is not a rare occurrence. Dental clinicians regularly encounter diagnostic challenges involving pain in the orofacial region.¹ Sometimes the pain is localized, but at other times it may be referred to a distant site. Although orofacial pain has a variety of causes involving a multitude of organs and structures in the head, face, and mouth, most patients seeking care on an outpatient basis in a dental clinic suffer from the most common cause of odontogenic pain: pulpitis.^{1,2} It is beyond the scope of this article to discuss all of the aspects of orofacial pain beyond odontogenic causes, a task that requires an entire textbook, but the goal is to introduce dental clinicians to a systematic approach to assess odontogenic pain and differentiate it from non-odontogenic pain. This way, either a restoration,

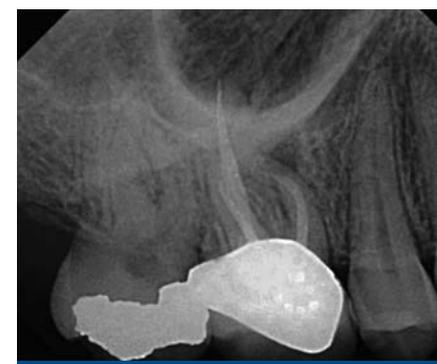


Figure 1 Preoperative view of tooth No. 3.



Figure 2 Preoperative view of tooth No. 30.



Figure 3 Postoperative view of tooth No. 30.



Ali Allen Nasseh, DDS, MMSC, PC

Clinical Instructor
Harvard School of Dental Medicine

Private Practice
Boston, Massachusetts

A SIGNIFICANT PIECE OF INFORMATION WHEN TREATING PATIENTS IN ACUTE PAIN IS LISTENING TO THEIR SPECIFIC CHIEF COMPLAINT.

endodontic therapy, or extraction can be performed to relieve pain, or the patient is properly triaged to the appropriate specialist for the necessary diagnosis and treatment.³

The diagnostic process for pain in the orofacial region is the process of gathering information from a patient with a specific chief complaint in order to diagnose the source of the complaint and triage for treatment. The gathered information is correlated to known pathological entities to develop a differential diagnosis. Because patient symptoms are a mix of subjective experiences and objective manifestations, it is imperative that a systematic, algorithmic approach to collect these findings be taken so that diagnostically relevant information is not missed. This can be through direct patient interview by the operator or a well-trained auxiliary member of the dental team. Proper communication of these symptoms also helps to assess the urgency of care and the potential perioperative and postoperative care and follow-up.

In reviewing the literature, the author has developed a 13-step diagnostic questionnaire that is the minimum required for a systematic collection of preliminary data for the diagnosis of the majority of odontogenic problems, as well as identification of potentially non-odontogenic sources of pain. This distinction is clearly very important to avoid unnecessary treatment of sources other than the primary cause of the patient's chief complaint. An understanding of non-odontogenic sources of pain that may mimic dental pain is, therefore, very important in avoiding a misdiagnosis.

NON-ODONTOGENIC OROFACIAL PAIN

Patients presenting to a dental office with what they feel to be odontogenic pain must be screened to eliminate any potentially non-odontogenic source to their symp-

toms. This is only possible with a thorough evaluation of the patient's chief complaint, review of the patient's past medical history, and the history of present illness (current symptoms), followed by a series of extraoral, intraoral, and radiographic examinations of the head, neck, and the affected sites to validate the symptoms. A distinction is to be made between subjective symptoms (those reported by the patient without any objective confirmation by the operator, eg, reported pain to cold, chewing, or percussion), and those objective symptoms that are readily observed by the operator (eg, swelling, mobility, or pus/bleeding from an area).

Because pain is an inherently subjective experience, many non-odontogenic sources of pain in the head and neck can cause diffuse, poorly localized pain that may confuse both the patient and the operator about their source.³ These include, but are not limited to acute sinusitis, temporomandibular disorder and associated myofascial pain syndromes, vascular pains, migraines, various forms of headaches, neuralgias,⁴ atypical odontalgias, and many other pathological conditions, including viral infections. Essentially, any mechanism that triggers stimulation of the trigeminal pain pathways along its entire circuit can mimic odontogenic pain through association or projection along the nerve's dermatomal divisions. (Once odontogenic sources of pain are ruled out beyond a reasonable doubt, referral to a physician, maxillofacial surgeon, ear, nose, and throat specialist, neurologist, or other specialists may be indicated depending on the likely non-odontogenic cause.)

In the author's practice, once the patient fills out the form, he or she is interviewed by a trained staff member and more detailed data is added to the form. The staff will then present the patient to the operator reviewing the information

while the operator asks specific additional questions to help construct the systematic differential diagnosis. This improves the efficiency of the diagnostic process by minimizing the operator's time in collecting raw data and focusing on the actual diagnosis.

STEP 1: CHIEF COMPLAINT

A significant piece of information when treating patients in acute pain is listening to their specific chief complaint. The patient's chief complaint very often directs the clinician in the right direction. In the clinical case mentioned above, if the readily diagnosable pathology was treated first instead of the patient's chief complaint, the patient's symptoms would have persisted after the initial treatment and resulted in an embarrassing misdiagnosis. Emergency care is about treatment of the chief complaint. It is, therefore, important that the chief complaint be noted in the patient's own words and recorded for medico-legal reasons. Further, any subsequent clinical test should try to duplicate the patient's chief complaint.⁵ Once the chief complaint is duplicated, valuable information is gained regarding the etiology of the disease and the source of the complaint. For example, if a patient's chief complaint is heat sensitivity but not cold, then thermal tests should include testing with heat and not just cold. If chewing is described as painful, then percussion and fracture detection tests should duplicate these symptoms. A tooth with a large alveolar swelling should not respond to thermal tests. If such a tooth was testing normal to thermal tests then a periodontal abscess or other sources of infection should be considered. A swelling of pulpal origin is generally expected only in the presence of a necrotic pulp with a negative thermal response. Understanding the role of pulpal vitality as it relates to thermal responses and swellings is paramount in making the correct diagnosis.

STEP 2: MEDICAL HISTORY, MEDICATIONS, AND ALLERGIES

The review of the medical history is not only important for assessing any potential medical emergencies during treatment, it is also a significant piece of the diagnostic puzzle for diagnosing non-odontogenic pain. Patients with a history of migraine headaches, fibromyalgia, trigeminal neuralgia, or other chronic debilitating conditions can potentially have manifestations of their symptoms in the orofacial regions, and these manifestations can mimic a toothache.³ A history

of other kinds of pain or trauma to the head, face, and the neck may also be relevant. Many acute viral infections, colds, influenzas, or recurrent manifestations of old viral infections in the orofacial regions can be a source of non-odontogenic pain during the course of the disease. Myocardial symptoms of angina or a myocardial infarction (MI) can potentially refer to the left side of the mandible and be confused with a toothache.⁵ Certain medications also may have the side effect of headaches or pains in the head and neck region that should be considered during the interview.

It is also important to inquire about the immediate past state of the patient's medical history. Patients suffering from the common cold, or a recent bout of the flu may have a primed immune response to localized infections of the pulp or may be suffering from sinusitis or other side effects associated with their illness.⁶

An unmedicated patient is easier to diagnose than one who is currently taking analgesics or has taken antibiotics. Patients currently experiencing mild pain may be easier to diagnose than asymptomatic patients because tests that relieve pain (selective anesthesia) can be diagnostic in localizing the source of their pain.⁷ It is important, therefore, for the front desk to instruct the patient to avoid analgesics for several hours before the diagnostic appointment.

STEP 3: HISTORY OF PRESENT ILLNESS (CHARACTERISTICS OF PAIN)

The third step of the diagnostic process is a significant one along the diagnostic path. A detailed history allows the construction of a clear picture of the patient's experience, information that should later corroborate with the clinical tests. The historical information, which is mostly subjective data, should be transposed over the objective data gained during the physical examination and the clinical tests so that a diagnostic picture emerges. The history also helps to differentiate between the acute versus chronic nature of the pain, its inflammatory versus neurogenic source, and an understanding of the urgency for care. This is important because time may be needed for maturation of symptoms and the decision to wait and postpone treatment versus immediate treatment may be influenced by the acuteness of the symptoms and the patient's perception.

Seven important questions are to be asked to properly communicate and assess the characteristics of pain as experienced by the patient:

When was the onset of the symptoms?

The first incidence of the pain related to a chief complaint is very important. This piece of information helps the clinician understand the acute versus chronic nature of the symptoms. If the patient

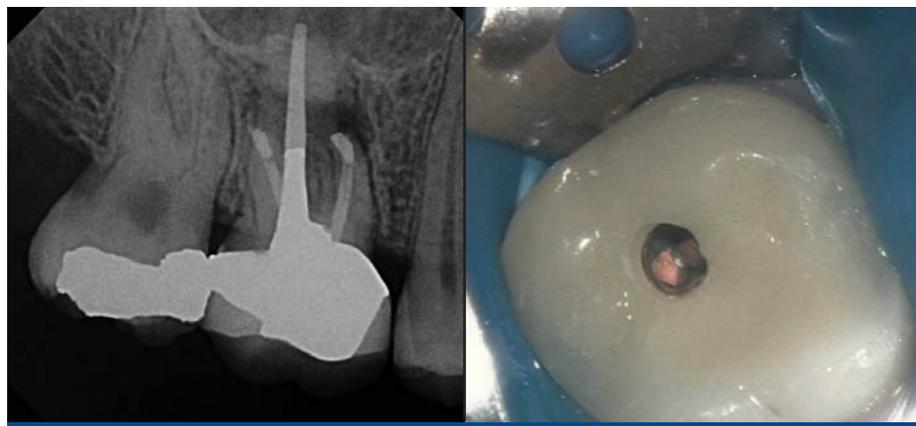


Figure 4 Postoperative view of tooth No. 3.

is unaware of the onset of pain, the pain is generally not as intense or acute and is more likely a low-grade discomfort. This may indicate a chronic condition. This information helps triage the urgency of treatment.

What is the location of the pain? The patient should be able to either physically draw or point to the pain center, as well as the boundaries of the place where pain is experienced. This should be done both extraorally and intraorally. This process helps to focus attention to potential sources of pain in the given area while considering the possible distant referral sites. If a patient's boundary of pain follows dermatomal outlines of a nerve, structures within that dermatome and adjacent dermatomes should be examined more closely.

What is the quantity/intensity of pain, on a scale of 0 to 10? Because pain is a subjective symptom, it is important to ask patients to rank their pain on a scale of 0 to 10, or a visual analogue scale, with 0 being no pain, and 10 being the worst pain imaginable. Understanding this number helps the clinician understand the acuteness of the pain and its importance to the patient as well as its relationship to various pathological processes. High numbers are often reported by patients suffering from odontogenic pain in the end stages of pulpitis when the pulp is going through necrosis.⁵ This can last from a few hours up to a few days, but rarely lasts more than several days or beyond a week, when the pulp necrotizes and the symptoms temporarily disappear. A chronically high score (more than a few days) should be investigated for non-odontogenic or potentially neurogenic sources of origin.⁵

What is the quality of pain? The distinction between sharp versus dull pain is a potential indication of the different nerve fibers associated with the patient's symptoms.⁸ Fast, myelinated A-Delta nerve fibers are often associated with sharp pain, whereas unmyelinated C-fibers are generally associated with a dull, aching type of pain.^{5,8,9} The significance of knowing which nerve fibers are involved in pain is that the fast fibers line the periphery of the pulp chamber adjacent to the dentinal surface and are, therefore, the first to get triggered.⁹ The C-fibers, on the other hand, are more centrally located (within the pulp proper) and their pain signals are generally associated with later stages of the disease process.^{5,8,9} Also, dentinal sensitivity is mediated by A-Delta fibers and is treated by desensitizing agents on dentin, whereas severe C-fiber sensitiv-

ity is generally symptomatic of the later stages of the disease process.^{8,9} To the same extent, while cold stimulus is generally triggered by fast fibers, heat stimulates the slow fibers, which accounts for dental pain that starts with cold sensitivity and proceeds into heat sensitivity as deeper parts of the pulp become involved. Also, patients who describe very sharp, stabbing, or an electrical-type pain quality with trigger zones may have pain of a neurogenic origin such as the one described in various forms of neuralgia.³ A burning sensation has been associated with causalgia and is triggered by sympathetic nerves. Such symptoms are generally non-odontogenic in origin. Tingling and numbness is also generally non-odontogenic, unless associated with an infection stemming from a tooth near a major nerve bundle.³

What are the temporal patterns of the pain? Questions relating to the temporal patterns of pain are questions like: is the pain constant or intermittent? If it is intermittent, how long does each attack last? What is the daily course of the symptoms? When is it worse—morning or night? Are there any seasonal variations to the symptoms?

Pain lingering after thermal stimulus has been generally associated with an irreversible pulpitis.⁵ If this complaint is corroborated during the clinical tests, the information becomes significant as it communicates a need for endodontic therapy. Attempting to remove decay and restore a tooth without endodontic therapy (if a history of spontaneous pain and severe, lingering response to thermal stimulus exists) is neither predictable nor wise.⁸ Duration of pain also communicates the acute versus chronic nature of the symptoms and, once again, the triage for urgent care. Once lingering or spontaneous pain is confirmed from a pulp, endodontic therapy should be initiated as soon as possible to avoid the later, more severe stages of pulpal degeneration or the ultimate development of an abscess. Odontogenic pain commonly manifests as intermittent pain with periods of acute exacerbation mixed with periods of relief.⁸ Complaint of constant pain for an extended period of time may require further investigation for potentially non-odontogenic sources.⁵ However, odontogenic pulpitis in its acute, irreversible phase can cause severe unrelenting pain in the end stages of the disease process and just before necrosis. Pain that is worse during the morning or upon waking

should be investigated with emphasis on eliminating potential occlusal trauma, temporomandibular disorder (TMD), and other myofascially related symptoms. A history of bruxism should be investigated in such patients.⁵

What makes the symptoms worse? Odontogenic pain is generally associated with a stimulus during normal eating. The cause of symptoms is often described first by the patient in the chief complaint. Either hot/cold stimulus, chewing, biting, brushing, or many other daily routines may suddenly result in pain.⁹ Each trigger can direct the diagnostician toward a specific plausible cause. Thermal pain is often pulpal in origin; but chewing pain may either be of pulpal origin, periodontal origin, or even a result of acute sinusitis, and it should be noted that occlusal trauma may also cause chronic chewing pain in a tooth.⁵ Cracked tooth syndrome is often associated with chewing pain, often upon release, and is unpredictable in its occurrence during normal chewing.¹⁰ This is because the correct angle of contact has to be met for the cracked dentin/enamel complex to move and open ever so slightly, producing the hydrodynamic forces necessary to cause pain.¹¹

Pain and stiffness in the morning may be indicative of myofascial pain secondary to nighttime bruxism.³ Tightness and clenching during the day or at work can also be cumulative with pain and soreness in the muscles of mastication toward the afternoon. Pain that is worse during the evening may be related to inflammatory pulpal causes or sinusitis, particularly if symptoms are worse while lying down or bending the head below the heart.⁶

A very significant piece of information is when a patient reports pain without any external cause, referred to as spontaneous pain. When this pain is of pulpal origin, it is often associated with irreversible pulpitis.⁵ It is important to note any incidence of spontaneous pain, as its presence indicates that the pulp will not recover and will likely deteriorate into necrosis.

What alleviates the symptoms? During end-stage pulpal disease (when the tooth is extremely sensitive to heat), cold stimulus may actually relieve the pain symptoms.⁵ Clinically, these patients present to the office in acute pain while sipping cold water from a cup for pain relief. Also, pain that is relieved by an over-the-counter analgesic further helps the clinician to quantify its intensity and understand the acute versus chronic nature of its cause.

As previously mentioned, alleviating a symptom may also be as helpful in diagnosing its source as is duplicating the symptom. Single-tooth anesthesia, followed by regional blocks, can help localize pain in the region distal to the site of anesthesia.⁷ When it cannot be determined if the origin of pain is from the maxillary posterior area or the mandibular posterior teeth, patients can have single-tooth anesthesia of the maxillary teeth,⁷ followed by a PSA block, and, lastly, a mandibular block. As soon as the patient's pain disappears it is possible to assume that the source of pain was distal to the location of anesthesia. An effective anesthetic technique, however, is necessary because failure of anesthesia during a mandibular block, for example, can cause a false-positive response. Selective anesthesia, however, should be the last clinical test and done after all other tests as it prevents further testing in the region.

STEP 4: PAST DENTAL HISTORY

The past dental history provides important information to investigate the patient's chief complaint in view of recent events in the mouth. The presence of recent restorations or evaluation of the quality of old restorations can shed light into the possible sources of pain. Even though recent restorations may or may not be the cause of the patient's presenting symptoms, there is a higher incidence of pulpitis in recent restorations, and therefore it is important to investigate them thoroughly as potential sources. Restorative procedures create some degree of pulpitis and the role of the diagnostician is to correlate the pulpitis symptoms to the patient's chief complaint, and make predictions about whether the pulpitis will subside or proceed to necrosis. In the example shown above, the information about the recent crown was instrumental in directing the attention to the opposing jaw and another potential source of pain. A small percentage of teeth proceed to pulpitis after the placement of restorations and they should systematically be ruled out as a source of referred pain in a patient who presents with discomfort in the same side of the face. As a rule of thumb, all recent restorations, especially those with a history of symptoms, should be ruled out whenever pain is a chief complaint in the same side of the face (in general, pain symptoms do not cross the midline and, therefore, pain on the right side of the face cannot be referred from a source in the left side).³

Once all relevant historical information about the chief complaint is gathered it is time for a physical examination. The role of the clinical examination is to duplicate the patient's historical symptoms and localize the source of pain. Therefore, this examination

BECAUSE PATIENT SYMPTOMS ARE A MIX OF SUBJECTIVE EXPERIENCES AND OBJECTIVE MANIFESTATIONS, IT IS IMPERATIVE THAT A SYSTEMATIC, ALGORITHMIC APPROACH...BE TAKEN SO THAT DIAGNOSTICALLY RELEVANT INFORMATION IS NOT MISSED.

should also be systematic in nature, so that important tests are not omitted.

STEP 5: EXTRAORAL EXAMINATION

An extraoral examination can be as brief as a quick look and minor palpation of tissues to as detailed as an examination of individual muscles, ear, nose, all dermatomes, and the auscultation of the TMJ. Therefore, it is important that this examination be directed toward the patient's chief complaint. A basic visual examination with emphasis on noting any changes in normal symmetry, tone, and color of the tissues should be followed by palpation of the lymph nodes and major muscles of mastication. Any swelling and deviations from normal in all tissues should be noted. Listen for abnormal clicking, popping, or deviations of the mandible from the midline during the opening and closing, and the maximum opening should be noted.¹²

A patient with a localized extraoral swelling that is warm and tender to palpation has a likely inflammatory-based pathology. That information, along with the intraoral tests and the history of the present illness should fit together to determine whether the tender swelling is odontogenic or non-odontogenic in origin. Palpation for tender lymph nodes helps to determine whether there is an active infection and where it may potentially originate from. Bilateral pain over the sinuses may indicate a bilateral sinusitis if it correlates to the rest of the picture of vital pulps and a history that reflects an anterolateral infection.⁶

STEP 6: INTRAORAL EXAMINATION

The intraoral examination provides significant information toward the diagnosis of the chief complaint. Here, it's important to have a thorough examination that is not just symptom-based. Missing obvious pathology, even though it may be irrelevant to the chief complaint, is every practitioner's legal responsibility. For example, missing a large cancerous lesion in the floor of the mouth may be negligent even though it may not have been the patient's chief complaint. A quick oral cancer screening



Figure 5 A fracture detector may help in detecting the source of pain.

by looking at the floor of the mouth and the lateral aspects of the tongue is always wise. Clinical presence of severely worn teeth with wear facets should trigger the possibility of occlusal trauma with clenching and bruxism. This history as well as a history of large restorations should direct the clinician to investigate potential cracks/fractures if the patient's chief complaint seems to coincide with that possibility.

After visual examination of all oral tissues bilaterally, periodontal and pulpal tests are performed.

STEP 7: PERIODONTAL EXAMINATION

Visual examination of the periodontal tissues (noting any recession and root exposure), localized probing of the region of chief complaint, and checking for any bleeding on probing, pus, and mobility is important in assessing the overall periodontal health of the patient.⁵ The presence of a sinus tract should be noted for later tracing during the radiographic exam. This is because the origin of a sinus tract is not necessarily the tooth directly adjacent to it. Because infection follows the path of least resistance, the source of an infection may be several teeth mesial or distal to the actual drainage site.

Several acute periodontal conditions, ranging from acute necrotizing ulcerative gingivitis to the common periodontal abscess, can be a source of pain. Secondary periodontal disease, related to occlusal trauma, may explain percussion pain in the patient. Pericoronitis is also a common cause of pain when food impaction in a pocket results in a localized periodontal abscess. Additional information about the periodontal bone will be assessed during the radiographic examination. The presence of periodontal disease should be noted during later vitality tests. A periodontal abscess or deep probing in a tooth with a vital pulp is not treatable by endodontic therapy, but instead, through non-surgical or surgical periodontal management of pocket.¹³

STEP 8: PERCUSSION TESTS

The percussion test provides information about the local apical and periodontal health of the tooth being percussed.



Figure 6 A refrigerant spray on a pellet.

The percussion test is not considered a vitality test and a positive percussion response does not indicate pulpal involvement. In combination with vitality tests, however, the percussion test can provide valuable information about the health of the pulp. Inflammation along the entire length of the periodontal ligament may cause percussion pain. This is why a positive percussion test should be evaluated in light of information from the periodontal examination, vitality tests, and occlusal tests. An acute periodontal abscess, later stages of a pulpal abscess, and even occlusal trauma may all cause percussion pain. Because cracked tooth syndrome is often associated with pain upon release, the percussion test alone may not duplicate this symptom. A fracture detector may help in isolating each cusp and duplicate the sensation of pain upon release (Figure 5). Percussion pain has also been reported in some cases of non-odontogenic pain such as atypical odontalgia³ or maxillary sinusitis when several teeth are involved.⁶ Although these are less common, it further highlights the importance of thorough testing and not relying on a single piece of information for a final diagnosis. A minimum of two corroborating pieces of information are needed to make a diagnosis.

STEP 9: PALPATION TESTS

The palpation test confirms if soft and hard tissues in the area are within anatomical normal limits. Any growths beyond normal should be noted. Painful response to palpation of a growth may indicate an inflammatory basis to the swelling. The consistency of the swelling to touch along with its visual inspection can shed light on its cause and nature. Putting pressure around a sinus tract's opening may cause drainage of pus. Intraoral palpation of the buccal aspects of the maxillary sinus may cause a dull ache if acute sinusitis is present.⁶

STEP 10: VITALITY TESTS

The purpose of a pulp vitality test is to determine if the pulp of any given tooth is vital, inflamed (reversible versus irreversible), or necrotic.⁵ Furthermore, these tests help to distinguish between the reversible and irreversible nature of a pulpitis. Three quick and easy vitality tests are available to the clinician: cold, hot, and the electric pulp test (EPT).¹⁴ It is important to realize that false-positive and false-negative results are possible with each test; therefore, much like each individual category of the diagnostic process, information obtained here should also be put in context of the overall clinical picture. But among the various vitality tests, the cold test is the most predictable and is very easy to perform.¹⁵ Application of a refrigerant spray to a cotton pellet and its placement on a vital tooth

should trigger a response that will subside within seconds of the removal of the stimulus (Figure 6). A lingering response to cold may be a sign of an irreversible pulpitis.¹⁶ Thermal sensitivity tests are often avoided by clinicians because of the discomfort they cause patients. Because this is one of the most significant tests in the diagnostic process, it is important to communicate its need to the patient. An explanation of the reason for this test and what to expect during the test should be given to the patient so that he or she can understand the necessity for it. This can also reduce the incidence of false positives resulting from patient anxiety.

The EPT is the least useful test and is generally used as an adjunct in questionable cases, when cold testing is unreliable.¹⁷ However, because of the high incidence of false positives, the EPT is most predictable when it produces no response, indicating a pulpless tooth.^{17,18} The choice of which vitality test to choose is based on the patient's chief complaint. Patients complaining of heat sensitivity should be tested with the heat test. A predictable heat test is individual isolation of each tooth with a rubber dam and placement of hot or cold water over the tooth.⁵ High-speed evacuation should be available during the test to remove the water from the tooth if a severe patient response is encountered. The vitality tests, like the other tests involved in the diagnostic process, are not in themselves indicative of a need for endodontic therapy. Again, two positive tests are needed to confirm the diagnosis because of the high incidence of false-positives and false-negatives with these tests.

STEP 11: RADIOGRAPHIC EXAMINATION

In diagnosing a pulpitis, the radiograph is not as useful as the history and vitality tests. Many clinicians mistakenly rely too much on the radiograph alone, foregoing proper gathering of history and vitality tests. Looking at a fresh radiograph from the area of the chief complaint, discovering a large radiolucency associated with a tooth's apex and deciding that the tooth has an abscess and requires endodontic therapy or extraction without any further testing has caused many misdiagnoses and mistreatments. Making a diagnosis based solely on a radiograph promotes bad habits because although it often works, the occasional misleading radiograph can result in a misdiagnosis and subsequent mistreatment.¹⁹ Significant cortical bone loss is required before any radiographic signs are observed. Therefore, radiographs have poor sensitivity in depicting bone loss resulting from a pathological process.^{20,21}

Several radiographs with multiple angles may be needed to amplify their usefulness. Periapical as well as bitewing radiographs are useful in assessing the

periapical and coronal health of any given tooth's supporting structures as well as existing restorations. Visual evaluation of the obtained radiographs should be done systematically, starting from the bone and moving into periodontium, root, pulp, and the coronal areas of the tooth, trying not to miss any areas.²² Particular attention to any changes deviating from normal in the bone and the presence of radiolucencies or opacities should be made. Large radiolucencies are generally associated with the apex of nonvital teeth. Thermal tests should be negative in such cases. Large radiolucencies associated with the apex of a vital tooth should be further investigated. Anatomical radiolucencies and lesions of non-pulpal origin should also be considered. A number of non-odontogenic radiolucencies and radio-opacities may be associated with the bone. Astute dental clinicians should be aware of all of the possible bony lesions associated with this region.

Vitality tests are still the best way to rule out a lesion of pulpal origin versus lesions of non-pulpal origin. Treatment of a radiolucency alone without vitality tests may result in endodontic treatment of a vital tooth with an anatomical radiolucency such as the mental foramen, or non-pulpal bone pathology such as a periodontal cyst, an odontogenic tumor, or even metastatic cancer.²³ As previously mentioned, whenever a sinus tract is present it should be traced. Tracing a sinus tract with a size 20/.04-taper gutta-percha cone can often show the source of the sinus tract radiographically. Although the rare presence of a pathological periapical radiolucency of pulpal origin has been demonstrated in teeth responding to vitality tests,²⁴ this is relatively rare and the presence of a large periapical radiolucency of pulpal origin should be assumed to be associated with a necrotic tooth.

STEP 12: OTHER TESTS, AS NEEDED

When the previous clinical tests are inadequate, additional tests may be necessary. Transillumination is used when a fracture is suspected. A test cavity may only be performed in rare cases, such as when no other option exists to determine the vitality of a tooth that is highly suspected to be the source of pain and postponing treatment for maturation of symptoms is not an option. Selective anesthesia is used when the source of acute pain cannot be determined with clinical tests. Single-tooth anesthesia using periodontal ligament injections or the use of blocks can anesthetize the source of pain and help diagnose cases of referred pain.⁷ Here, however, whenever all tests are exhausted without a clear diagnostic picture, it is important to remember that waiting eventually allows localization of the symptoms.

STEP 13: DIFFERENTIAL DIAGNOSIS

It is important to understand that diagnostic decisions are differential in nature.²⁵ This means that all diagnostic possibilities are ranked in descending order of plausibility. Only after treatment, or a biopsy with pathological confirmation, can a definitive diagnosis be achieved. This is the rationale for a thorough data collection as only then can it provide enough data to help differenti-

ate between various conditions that have several symptoms in common.

TREATMENT

While treatment is not itself a component of the diagnostic process, it is worth mentioning because patients seek relief from their symptoms, not just an understanding of their causes. In general, for the diagnosis of pulpal disease, two separate and distinct tests should be positive to initiate treatment.⁵ For example, a negative cold

response and positive percussion test, a lingering thermal response and a history of spontaneous pain (indicating irreversible pulpitis), or the presence of a radiolucency and a negative vitality response are all indications for endodontic pathology that require either endodontic treatment or extraction. The presence of deep probing in a non-vital tooth or the presence of a sinus tract pointing to the apex of a non-vital tooth, or swelling adjacent to a non-vital tooth, are also indications for

endodontic treatment. In the absence of adequate information, however, treatment is best postponed. The risk of performing the wrong treatment should always be balanced against the emergency needs of the patient. Here, effective, honest communication with the patient can avoid a misunderstanding by the patient that his or her feelings and emergency needs are being ignored by the clinician.

Because all pulpal pain is not necessarily irreversible in nature, it is also im-

portant to distinguish between reversible and irreversible pulpitis (Figure 7). In reversible pulpitis, when thermal responses do not cause lingering pain and spontaneous pain is not present, removal of the source of pulpal irritation may cause relief. Microleakage around restorations from old, deteriorating fillings or bond breakdown around a bonded restoration, presence of frank decay, occlusal trauma, and several other factors can all cause a pulpitis that can improve once the source is removed. But it is also im-

portant to understand that pulpal necrosis should be avoided in all cases. Necrotic pulps with periapical lesions have been shown clinically to have a lower endodontic success rate compared to their vital counterparts. It is imperative, therefore, to be proactive and treat strategically important teeth that will likely become necrotic later and avoid a lower endodontic success rate in those situations.

CONCLUSION

Understanding possible referral patterns for pain, various odontogenic/non-odontogenic diseases in the orofacial region, and a thorough understanding of the role that pulp vitality plays in the progression of various pathological processes is paramount in developing the proper differential diagnosis.

Because effective diagnosis is dependent on the proper collection of relevant data, a systematic approach to data collection is necessary if the clinician wants to maximize the potential for making the correct diagnosis. The 13-step diagnostic approach can be a systematic approach to collecting data that, in conjunction with wise interpretation, can lead to predictable diagnosis and the triage of patients suffering from orofacial pain.

In summary, several rules may be helpful in understanding the basis of the 13-step approach to diagnosis. They

are as follows:

1. Always address the chief complaint first.
2. Try to duplicate the patient's chief complaint with clinical tests.
3. Take a thorough history of symptoms and listen to the patient's description of pain characteristics.
4. Require a minimum of two definitive test results before presenting a differential diagnosis.
5. Do not hesitate to refer and/or wait in the absence of rule 4.
6. Understand that radiographs have limited diagnostic ability.
7. Lingering thermal pain and a history of spontaneous pain of pulpal origin are generally irreversible symptoms.
8. There may be occasional exceptions to any of the above rules, but not to the rule below!
9. Understand that all conditions and symptoms are not diagnosable in all patients all the time. Many limitations in collecting case-pertinent information as well as patient variability make diagnosis an art as well as a science. In the absence of evidence pointing to a clear diagnosis, no treatment is the most conservative option. Referral or monitoring is required in such situations instead of indiscriminate action.

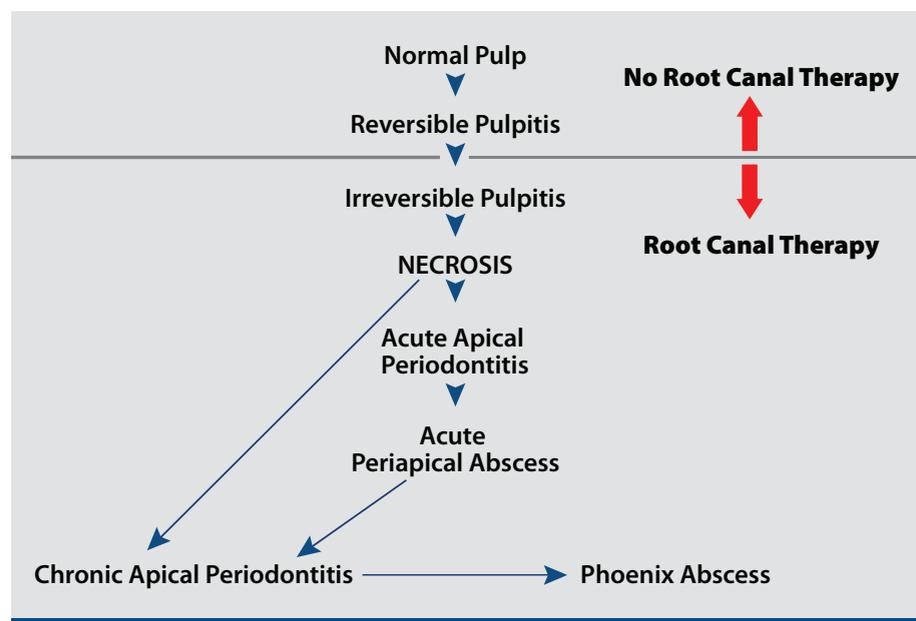


Figure 7 Reversible versus irreversible pulpitis.

REFERENCES

- Lipton JA, Ship JA, Larach-Robinson D. Estimated prevalence and distribution of reported orofacial pain in the United States. *J Am Dent Assoc.* 1993;124:115-121.
- Hasselgren G, Calev D. Endodontics emergency treatment sound and simplified. *N Y State Dent J.* 1994;60(6):31-33.
- Okeson JP, Bell WE. *Bell's Orofacial Pains.* 5th ed. Chicago: Quintessence Publishing Co; 1995.
- Pinsawasdi P, Seltzer S. The induction of trigeminal neuralgia-like symptoms by pulp-periapical pathosis. *J Endod.* 1986;12:73-75.
- Cohen R, Burns RC. *Pathways of the Pulp.* 8th ed. St. Louis: Mosby, Inc; 2002.
- Selden HS. The endoantral syndrome. *J Endod.* 1997;3:462.
- Smith GN, Walton RE. Periodontal ligament injection-distribution of injected solutions. *J Oral Surg.* 1983;55:232-238.
- Seltzer S. *Endodontology: Biologic Consideration in Endodontic Procedures.* 3rd ed. Philadelphia: Lea and Febiger; 1988.
- Kim S. Neurovascular interactions in the dental pulp in health and inflammation. *J Endod.* 1990;16:48-53.
- Cameron CE. The cracked tooth syndrome. *J Am Dent Assoc.* 1976;93:971-975.
- Brannstrom M. Etiology of dentin hypersensitivity. *Proc Finn Dent Soc.* 1992;88 (Suppl 1):7.
- Guralnick W, Kaban LB, Merrill RB. Temporomandibular joint affliction. *N Engl J Med.* 1978;299:123.
- Simon JH, Glick DH, Frank AL. The relationship of endodontic-periodontic lesions. *J Periodontol* 1972;43:202-208.
- Fulling HJ, Andreasen JO. Influence of maturation status and tooth type of permanent teeth upon electometric and thermal pulp testing. *Scand J Dent Res.* 1976;84:286.
- White JH, Cooley RL. A quantitative evaluation of thermal pulp testing. *J Endod.* 1977; 3:453.
- Cecic PA, Hartwell GR, Bellizzi R. Cold as a diagnostic aid in cases of irreversible pulpitis. *Oral Surg Oral Med Oral Pathol.* 1983; 56(6):647-650.
- Fuss Z. Assessment of reliability of electric and thermal pulp testing agents. *J Endod.* 1986;12:301.
- Matthews B, Searle BN. Some observations on pulp testers. *B Dent J.* 1974;137: 307-312.
- Council on Dental Materials, Instruments, and Equipment: Recommendations in radiographic practices: an update. *J Am Dent Assoc.* 1989;118:115.
- Bender IB, Seltzer S. Roentgenographic and direct observation of experimental lesions in bone: I. 1961. *J Endod.* 2003; 29(11):702-706.
- Bender IB, Seltzer S. Roentgenographic and direct observation of experimental lesions in bone: II. 1961. *J Endod.* 2003; 29(11):707-712.
- Wuehrmann AH. Radiation hygiene and its practice in dentistry are related to film viewing procedures and radiographic interpretation. *J Am Dent Assoc.* 1970;80(2): 346-356.
- Bhaskar SN, Rappaport HM. Dental vitality tests and pulp status. *J Am Dent Assoc.* 1973;86(2):409-411.
- Lin LM, Skribner J. Why teeth associated with periapical lesions can have a vital response. *Clin Prevent Dent.* 1990;12:3(1): 3-4.
- Drinnan AL. Differential diagnosis of orofacial pain. *Dent Clin North Am.* 1987;31(4): 627-643.



GlaxoSmithKline
Consumer Healthcare



CONTINUING education

QUIZ

Log on to www.insidedentistryCE.com to take this FREE CE quiz.

A Systematic Approach to Endodontic Diagnosis: A 13-Step Process

Ali Allen Nasseh, DDS, MMSC, PC

Tufts University School of Dental Medicine provides 2 hours of **FREE** Continuing Education credit for this article for those who wish to document their continuing education efforts. To participate in this CE lesson, please log on to www.insidedentistryCE.com, where you may further review this lesson and test online. Log on now, take the CE quiz and, upon successful completion, print your certificate immediately! It's that easy! For more information, please call 877-4-AEGIS-1.

- The gathered information is correlated to known pathological entities to develop a:
 - accurate diagnosis.
 - absolute diagnosis.
 - differential diagnosis.
 - distributive diagnosis.
- Symptoms reported by the patient without any objective confirmation by the operator, eg, reported pain to cold, chewing, or percussion are:
 - clinical.
 - historical.
 - subjective.
 - objective.
- Emergency care is about treatment of the:
 - infection.
 - carious lesion.
 - chief complaint.
 - pain.
- The history also helps to differentiate between:
 - the acute versus chronic nature of the pain.
 - its inflammatory versus neurogenic source.
 - an understanding of the urgency for care.
 - all of the above
- Which fibers are generally associated with a dull, aching type of pain?
 - A-Lambda
 - A-Beta
 - A-Delta
 - unmyelinated C
- Pain without any external cause is referred to as what type of pain?
 - lingering
 - spontaneous
 - thermal
 - inflammatory/necrotic
- Among the various vitality tests, which test is the most predictable?
 - cold
 - heat
 - percussion
 - EPT
- Which tests are still the best way to rule out a lesion of pulpal origin versus lesions of non-pulpal origin?
 - peri-apical radiograph
 - bitewing radiograph
 - vitality
 - percussion
- Whenever all tests are exhausted without a clear diagnostic picture, it is important to remember:
 - to always treat something.
 - necrotic pulps will not localize symptoms.
 - vital yet inflamed pulps will not localize their symptoms.
 - that waiting eventually allows localization of the symptoms.
- In general, for the diagnosis of pulpal disease, how many separate and distinct tests should be positive to initiate treatment?
 - one
 - two
 - three
 - four

Tufts University School of Dental Medicine is an
ADA CERP and ACDE recognized provider.

ADAC•E•R•P
CONTINUING EDUCATION RECOGNITION PROGRAM

ACDE Association
for Continuing
Dental Education

Mail in Answer Form

Inside Dentistry is committed to your Continuing Education efforts. We are pleased to offer you another avenue for obtaining credits for your Continuing Education lessons. In addition to our FREE CE on our Web site, www.insidedentistryce.com, we are now offering a mail-in option to our readers who prefer to send in their tests for scoring. For a nominal fee of \$28 (\$14 per credit) to cover administrative and handling costs, your test will be graded and your certificate will be sent to you in the mail. Simply use this page for your answers, fill it out completely, and send it along with your check or credit card information for \$28 to the address below. Please allow approximately 2-3 weeks for processing.



inside
Dentistry

JUNE 2009

A Systematic Approach to Endodontic Diagnosis: A 13-Step Process

- | | | | | | | | | | |
|----|---|---|---|---|-----|---|---|---|---|
| 1. | A | B | C | D | 6. | A | B | C | D |
| 2. | A | B | C | D | 7. | A | B | C | D |
| 3. | A | B | C | D | 8. | A | B | C | D |
| 4. | A | B | C | D | 9. | A | B | C | D |
| 5. | A | B | C | D | 10. | A | B | C | D |

CHECK (payable to AEGIS Communications)

CREDIT CARD – Please complete information and sign below:

Card Number

□□□□□□□□□□□□□□□□

Expiration Date: Mo/Y

□□/□□□□

Visa **MasterCard** **American Express**

Total amount _____ (\$28 per test)

SIGNATURE _____

DATE _____

(PLEASE PRINT CLEARLY)

Last 4 digits of the SSN □□□□

ADA Number □□□□□□□□□□

AGD Number □□□□□□□□

The Month and Day (not year) of Birth. Example, Jan 23 is 01/23.

Month/Date of Birth _____

Name _____

Address _____

City _____

State _____ Zip _____ Daytime Phone _____

Please mail completed forms with your payment to: AEGIS Communications
CE Department, 104 Pheasant Run, Suite 105, Newtown, PA 18940

SCORING SERVICES: By Mail • Fax: 215-504-1502 • Phone-in: 877-423-4471 (9 am-5 pm ET, Mon.-Fri.)
Customer Service Questions? Please Call 877-423-4471

PROGRAM EVALUATION

Please mark your level of agreement with the following statements.

(4 = Strongly Agree; 0 = Strongly Disagree)

- | | | | | | |
|--|-----------|----|---|---|---|
| 1) Clarity of objectives | 4 | 3 | 2 | 1 | 0 |
| 2) Usefulness of the content | 4 | 3 | 2 | 1 | 0 |
| 3) Benefit to your clinical practice | 4 | 3 | 2 | 1 | 0 |
| 4) Usefulness of the references | 4 | 3 | 2 | 1 | 0 |
| 5) Quality of the written presentation | 4 | 3 | 2 | 1 | 0 |
| 6) Quality of the illustrations | 4 | 3 | 2 | 1 | 0 |
| 7) Clarity of review questions | 4 | 3 | 2 | 1 | 0 |
| 8) Relevance of review questions | 4 | 3 | 2 | 1 | 0 |
| 9) Did this lesson achieve its educational objectives? | Yes | No | | | |
| 10) Did this article present new information? | Yes | No | | | |
| 11) How much time did it take you to complete this lesson? | _____ min | | | | |

DEADLINE FOR SUBMISSION OF ANSWERS IS 24 MONTHS AFTER THE DATE OF PUBLICATION.