Cold as a diagnostic aid in cases of irreversible pulpitis

Report of two cases


Two case reports are presented to illustrate the effectiveness of cold in localizing the offending tooth in difficult diagnostic situations where painful pulpitis is present. A review of the literature reveals that there are several proposed theories concerning the mechanisms by which cold relieves the painful symptoms present in some cases of irreversible pulpitis. The hydrodynamic theory seems to provide the most feasible explanation of the events that occur.

Occasionally a patient is seen with symptoms of severe pain of a boring, gnawing, or throbbing type. The pain may be increased by heat and relieved by cold, although in some cases continued application of cold may intensify the pain. This patient may appear solemn but bemused as he holds a container of ice or ice water to his face. He has learned from experience that this will allay the pain.

In 1960 Mitchell and Tarplee1 rebutted the axioms that "cold hurts and heat relieves pulpitis" and that "heat hurts and cold relieves a necrotic pulp." In their study of 26 cases of teeth with painful pulpitis, 25 teeth gave hypersensitive responses to applications of both heat and cold. In all 26 teeth, pulpal exposures were detected by both clinical and histologic methods.

Dachi2 found a proportionally direct association between inflammation and sensitivity to heat, while Lundy and Stanley3 found that severe clinical responses usually accompanied acute histologic states of the pulp where leukocytes predominated. An association between increasing degrees of inflammation and sensitivity to cold was suggested, although this was not statistically significant. There is a diversity of opinions1-7 concerning the relationship between certain clinical signs and symptoms and the histopathologic status of the pulp, and it is not our purpose here to belabor the controversy.

The objects of this article are to present two case reports in which cold testing proved to be the key in the diagnosis of irreversible pulpitis and to discuss the possible mechanisms by which cold relieves painful pulpitis.

CASE 1

A 63-year-old white man presented to the endodontic service for diagnosis and treatment. The patient entered the operatory carrying a jar of ice water which he held to the right side of his face and from which he occasionally took a drink (Fig. 1). The chief complaint was severe pain in the maxillary right posterior region. A past medical history of hypertension, controlled by dyazide, was recorded. The patient had been seen 2 days previously for emergency dental treatment. At that time, the attending dentist extirpated the pulps from the mandibular right canine and first premolar. When the local anesthetic effect dissipated, the severe pain returned. The only method the patient found to control the pain was with the ice water.

All findings of the radiographic and clinical examinations of the teeth in the maxillary right posterior quadrant were within normal limits. A radiograph of the mandibular right second molar revealed a widened periodontal ligament space at the apices of both roots (Fig. 2). Intraoral examination of the lower right quadrant revealed a porcelain-fused-to-metal crown on the mandibular right canine and a gold bridge using the mandibular right first premolar and second molar as abutments. None of the teeth on the

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Fig. 1. Case 1. The patient came to the dental clinic holding a jar of ice water to the right side of his face.

right side was sensitive to percussion or palpation. However, at approximately one-minute intervals, the patient halted the examination and took a mouthful of ice water (Fig. 3). It was noted that the patient positioned his head and directed the ice water toward the most posterior recesses of the mandibular right side. The mandibular right second molar was isolated with cotton rolls and, as the pain returned, an ice stick was placed on this tooth. That brought immediate relief of the pain. This was repeated several times, with the same results.

A right inferior alveolar nerve block was given, and the pain immediately disappeared. No significant findings were noted upon re-evaluation of the maxillary right posterior teeth. The pulp was extirpated from the mandibular right second molar, and the patient did not experience any recurrence of the symptoms. Root canal therapy was completed at a later appointment (Fig. 4).

**CASE 2**

A 62-year-old white man reported to the dental clinic because of extreme pain in the maxillary left posterior quadrant. Administration of a local anesthetic by the attending dentist calmed the patient, and a dental examination was performed. The patient was then referred to the endodontic service for further evaluation and emergency treatment. The medical history was noncontributory. The dental history revealed that three previous attempts had been made to alleviate the pain.

At the first visit, pain seemed to have been the result of food impaction between the maxillary left canine and first premolar. The interproximal area was curetted and contoured to alleviate this problem. The patient returned in pain, and the maxillary left first premolar was identified as being very sensitive to heat and percussion. Clinical examination confirmed these findings, and the attending dentists extirpated the pulp. The patient was last seen in the emergency room at the hospital, and again the chief complaint was of pain in the maxillary left first premolar. This tooth was reopened, irrigated, and resealed. The pain was relieved until 6 A.M. the following day, at which time the patient discovered that only cold water placed intraorally would relieve the pain. Clinical examination at 9:30 A.M. by the endodontist revealed a porcelain-fused-to-metal bridge extending from the first premolar to the second molar. Additional pulp tests could not be performed at that time because of the local anesthetic that had been administered by the examining dentist. The first premolar was completely instrumented and a sterile cotton pellet was sealed in the pulp chamber.

The patient returned at 1 P.M., stating that the severe pain had returned when the effects of the local anesthetic subsided. The pain was again relieved only when cold water was placed intraorally in the maxillary left posterior area. A radiograph (Fig. 5) of the maxillary left second and third molars failed to reveal any periapical changes. A periodontal defect associated with the mesiobuccal root of the third molar was noted on the radiograph and confirmed clinically. Initially, the placement of an ice stick on the maxillary left second molar relieved the pain. However, continued placement of the ice on this tooth evoked a painful response. Carefully timed placement of the ice stick to the tooth provided relief. Placement of ice on the third molar did not affect the pain. Access was prepared in the second molar and a friable, fragmented pulp was extirpated. This was accompanied by copious hemorrhage. When all tissue fragments were removed, the hemorrhage

Fig. 2. Case 1. Preoperative radiograph of the mandibular right second molar.
ceased. The patient did not experience any recurrence of the pain upon completion of this treatment. Prior to completion of the root canal therapy, the maxillary third molar was extracted for periodontal reasons. Root canal therapy was completed at subsequent appointments (Fig. 6).

DISCUSSION

The foregoing case reports offer several similarities: (1) Both were difficult to diagnose, (2) both exhibited referred pain, (3) in both cases multiple teeth were treated endodontically, (4) in both cases the symptoms could be relieved with ice water applications, (5) both teeth were molars with full gold crowns serving as posterior bridge abutments, and (6) both were asymptomatic following pulp extirpation.

Van Hassel and Harrington stated that clinicians may rely with some degree of confidence on the patient's ability to choose the proper quadrant when pain is difficult to localize. Mandibular posterior teeth appear to have the greatest potential for erroneous identification of the tooth with pulpal pain. This was demonstrated in Case 1, in which pain was referred from the mandibular molar to the mandibular canine and first premolar as well as to the maxillary molars. In Case 2 the proper quadrant was identified as the maxillary second molar referred pain to the maxillary first premolar.

In the first case, it is understandable that the inferior alveolar nerve block would produce relief of pain. In the second case, unexpected relief of pain in the maxillary second molar was obtained when local anesthetic was administered over the maxillary first premolar. The anesthetic test was useful in determining the quadrant in each of these cases.

Is there a possible mechanism for relief of pain with the administration of cold in the patient who has clinical signs and symptoms of irreversible pulpitis? In both cases reported here application of ice for a few seconds produced an immediate, transient relief of pain. Beveridge and Brown demonstrated that cold stimuli could decrease intrapulpal pressure by 28 mm Hg. This was considered to be a direct result of...
of the vasoconstriction of the pulpal blood vessels in response to the cold stimulus. In 1970, Johnson and associates\textsuperscript{10} found that a 5-second application of cold did not produce a “relative” vasoconstriction. Trowbridge and others\textsuperscript{11} found that when cold was applied, the temperature in the region of the pulpodental junction continued to decrease for approximately 20 seconds after the sensory response had disappeared. This was considered further evidence that the sensory structures were not responding directly to temperature change.

In the hydrodynamic theory, Brannstrom\textsuperscript{12} postulated that the capillary action of fluid in the dentinal tubules resulted in the transmission of pain between the tubules and vital pulp tissue in the more apical portions of the pulp chamber and root canal system, even though there was necrotic tissue or hemorrhage in the intervening area. This would seem to account for the sensitivity to tactile stimuli and changes in temperature, even though a large portion of the coronal pulp might be necrotic. The coefficient of expansion of dentin fluid is estimated to be approximately ten times greater than that of the tubule wall. Cooling of dentin would result in a contraction of the tubules’ contents with a resultant flow of the fluid away from the pulpal tissues.

During acute inflammation, there is an accumulation of polymorphonuclear neutrophils and dilatation of capillaries which allows plasma proteins to escape into connective tissue spaces.\textsuperscript{13} The resultant edema could cause pressure on the pulpal and/or periradicular nerve fibers and elicit a painful response. Van Hassel\textsuperscript{14} found that in human teeth the intrapulpal pressure could increase an average of 15 mm Hg in an area of local inflammation. The application of a cold stimulus could, in turn, result in contraction of the dentinal fluid and decrease the pressure within the pulp, yielding a rapid transient reduction of pain. This would be especially true in a tooth with gold coverage, since the metal serves as an excellent thermal conductor. Considering the immediate relief of pain obtained following cold application, the hydrodynamic theory would seem the most feasible explanation of the events that occur.

**SUMMARY AND CONCLUSIONS**

Two cases are reported in which the diagnosis of irreversible pulpitis was facilitated by the placement of ice on the affected tooth to obtain relief of pain. The hydrodynamic theory seemed to provide the most feasible explanation of the events that occur when ice provides relief of pain in the pulpally involved tooth. These case reports point out the importance of not overlooking the value of cold as a diagnostic aid in pulp-testing procedures.

**REFERENCES**


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