

# Assessment: Thermography in neurologic practice

Report of the American Academy of Neurology, Therapeutics and Technology Assessment Subcommittee

**I. Overview.** Infrared thermography provides information about the relative emission of infrared energy from the surface of the body. Information on how the test should be performed and interpreted is available. A controlled ambient environment is needed, and photographs must be repeated to ascertain that emissions are stable. There are differences among anatomic sites but only small differences between sides of the body.<sup>1-8</sup> The variabilities related to testing technique and to the influence of site, age, sex, height, weight, physiologic condition, and disease variables have not been explored adequately. Although there are published statements that age does not affect emission,<sup>8</sup> the data provided are insufficient to establish that the question has been adequately addressed. Infrared energy emission changes after nerve injury and vessel occlusion, but the underlying pathophysiologic mechanisms, particularly in chronic lesions and especially those affecting nerve roots, are not clearly understood.<sup>9</sup> The influence of labile vasomotor responses and dermatologic condition also needs further study.

**Reported uses.** Thermography has been reported to be useful in the detection and characterization of nerve root irritation and compression<sup>3,4,10-34</sup>; peripheral nerve injury, entrapment, and reflex sympathetic dystrophy<sup>9,35-44</sup>; occlusive disease of cranial vessels and mechanisms associated with headaches<sup>45-50</sup>; and spinal cord abnormality<sup>51-53</sup> and in distinguishing neuropathic from nonphysiologic pain syndromes.

In reviewing published reports and volunteered and solicited statements on the value of thermography in neurologic practice, the Therapeutics and Technology Assessment Subcommittee found considerable polarization of opinion. Some respondents reported excessive and inappropriate use of the technique. The majority thought that the technique was useful for certain specific purposes.

The Subcommittee found that thermography is useful in neurologic practice but that it is better for some purposes than others and that further critical work is needed to define its use, value, and limitations.

**Favorable characteristics of thermography.** Assuming that thermography is useful in the characterization of neurologic dysfunction, it has several appealing features: it is painless and noninvasive, it has no adverse biologic effect, it is objective (except in a few trained patients, responses probably cannot be willed), it produces a permanent record, and it is not more expensive

than many other evaluative procedures.

**Radiculopathy.** Thermography has been reported to be useful for the detection of cervical and lumbar nerve root irritation and compression. It has been reported to be sensitive (recognizing a radiculopathy, given that one is present) and specific (not recognizing it when one is absent) compared with computed tomography (CT), myelography, electromyography (EMG), or surgical exploration. However, it should be appreciated that, in this context, agreement with results of contrast studies or surgical findings was judged to have occurred when thermography revealed an abnormality (either cooler or warmer) in the general vicinity of the cutaneous distribution of the nerve root. The sensitivity and specificity of the test would be low if precise localization (to correct side and segmental level) and to pathologic process (disk, tumor, or other) were the criteria of thermographic success. Lack of precision of thermographic localization may have influenced other investigators to report that the test was not sensitive or specific.

Perhaps more important than the question of sensitivity and specificity is the question of the clinical usefulness of the test. Does thermography provide as much or the same information as EMG, CT, MRI, and myelography? EMG provides information about the root or nerve involved, side the lesion is on, chronicity, kind of lesion (demyelinating or axonal degeneration), and occurrence of regenerative events. CT, MRI, and myelography provide more specific information about site, severity, and structural features of the lesion. EMG provides more localizing and characterizing information than does thermography, whereas CT, MRI, and myelography provide more specific information about site, size, and kind when there is a space-occupying lesion. On the other hand, EMG and thermography may reveal parenchymatous or interstitial root or nerve abnormalities when CT, MRI, and myelography are negative. Knowing that radiculopathy is present is helpful in diagnosis and treatment.

Hubbard's observation<sup>25</sup> that, when thermography is negative, nerve root compression will not be found by myelography led him to suggest that the test be used "in those cases where it is felt necessary to proceed beyond conservative therapy to work-up." He found the test to be "an effective screening method for recognizing a pathological abnormality before proceeding with CT scanning or myelography." Other workers have not found thermography to be that sensitive or specific.

Irrespective of the results of future studies, it is unlikely that thermography will be found to provide precise information about site, size, and kind of pathologic abnormality of nerve roots. CT, MRI, and myelography provide this more-specific information about space-occupying lesions.

The Subcommittee finds that thermography probably is not needed in many cases of neck or back pain suspected to be associated with nerve root irritation or a compressive lesion caused by a disk or tumor. The test probably is not indicated for patients who have mild or short-lived neck or back pain with neurologic findings and who will not be considered for surgical treatment. It is not necessary either for patients who have obvious clinical radiculopathies requiring the more definitive studies of CT, MRI, or myelography. Thermography may provide characterizing information in those cases in which it would be helpful to know whether nerve root or segmental nerve is or is not affected and confirmation of involvement is needed. Compared with EMG, it provides less information about localization and pathologic events. Compared with CT, MRI, or myelography, thermography provides less localizing and diagnostic information. Based on current information, the Subcommittee does not support the use of thermography as a screening test for patients with neck or back pain.

*Peripheral nerve injury.* Thermography has been reported to be useful in the characterization of entrapped and injured peripheral nerves and of reflex sympathetic dystrophy (RSD) and in providing supportive evidence for the diagnosis of nonorganic pain disorders. So et al<sup>54</sup> found EMG to be superior to thermography in confirming the diagnosis of carpal tunnel syndrome.

The Subcommittee finds that thermography is not a primary evaluative technique for the detection and diagnosis of peripheral nerve lesions. Its use in the assessment of entrapped nerves is not promising. Thermography may be a useful adjunctive procedure for characterizing peripheral nerve injury and RSD. Although thermography may be sensitive to the detection of RSD, it is not diagnostic. Its use in detection and characterization of polyneuropathy is not established.

*Spinal cord disease.* Thermographic abnormalities reportedly occur in more than 1/2 of the patients with certain spinal cord abnormalities. Although the case is made that thermography is useful in detection, characterization, and follow-up, the Subcommittee judges that better approaches are available for this purpose.

*Headache and impending stroke.* Thermography is also being used to study vascular phenomena associated with headache. Cluster headache has been reported to be associated with a characteristic thermographic pattern in approximately 2/3 of the patients. Because cluster headaches are diagnosed by characteristic symptoms and absence of neurologic abnormalities, the Subcommittee does not believe that thermography is sufficiently useful to become a standard evaluative procedure in cases of headache.

Thermography has been used to study the adequacy of blood flow to the hemispheric brain in order to detect decreased blood flow to the brain. The Subcommittee

does not believe that sufficient evidence has been developed to merit use of the procedure for the clinical assessment of headache or transient cerebral ischemia.

*Prevention of mutilating acropathy.* Thermography has been used to study patterns of hand and foot use in acts of daily living in patients with acral insensitivity so that activity and footwear can be modified to prevent acral mutilation. In a setting where many patients with acral insensitivity are seen, the application of the technique seems appropriate.

**II. Executive summary.** A. Based on the present medical literature, infrared thermography is of limited value in the characterization of neurologic dysfunction or deficit. If it is to be used, it should only be in conjunction with established neurodiagnostic evaluative procedures. Infrared thermography may provide information about altered cutaneous temperatures useful in characterizing reflex sympathetic dystrophy, focal autonomic neuropathies, focal nerve injuries, and for evaluation of faulty use of insensitive acral parts.

B. Based on the present medical literature, infrared thermography has not been shown to provide sufficient reliable characterizing information about neurologic dysfunction or deficit to accept it as a proven evaluative procedure for the clinical diagnosis or characterization of (1) neck or back pain and/or cervical, thoracic, or lumbosacral radiculopathy; (2) musculoskeletal pain; (3) entrapment neuropathy; or (4) headache, transient cerebral ischemia, or stroke.

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*This statement is provided as an educational service of the Academy of Neurology to promote the quality and cost effectiveness of health care. It is based on current scientific and clinical information, and does not represent an endorsement by the AAN of particular diagnostic and therapeutic procedures or treatment, recognizing that specific patient care decisions are the responsibility of the patient and the physician caring for the patient, based on all of the circumstances involved.*

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