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Guidelines For Dental-Oral And Systemic Health Infrared Thermography

American Academy of Thermology - AAT

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General Statement — This guideline was prepared by members of the American Academy Of Thermology (AAT) as a guide to aid the performance of Dental/Systemic Health infrared imaging in evaluating patients with Dental-Oral and Systemic Health related complaints. It implies a consensus of those substantially concerned with its scope and provisions. The AAT guideline may be revised or withdrawn at any time. The procedures of the AAT require that action be taken to reaffirm, revise or withdraw this guideline no later than three years from the date of publication. Suggestions for improvement of this guideline are welcome and should be sent to the executive director of the American Academy of Thermology.

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STATEMENT OF NEED

Thermography is a non-invasive technology available to image and map microcirculatory shunting associated with circulatory changes in the skin. It can play an important adjunctive role in the assessment of Dental-Oral and certain Systemic Health related illnesses, diseases, and in their clinical diagnosis. When performed and interpreted within the scope of this Guideline Dental/Systemic Health Thermography can also play a useful role in monitoring treatment effects of dental-oral and specified systemic health conditions.

Other structural imaging technologies such as X-Ray, Ultrasound, CT, and MRI, do not provide the information offered by Dental/Systemic Health Thermal Imaging. The clinical application of Thermography can help physicians both understand patho-physiology and improve patient outcomes.

The American Academy of Thermology supports the incorporation of infrared thermal imaging into clinical medicine and its specific utility in the monitoring of dental-oral and applicable systemic health conditions. The AAT recognizes a current and ongoing need to promulgate continuing dental/systemic health education in the science and methods of thermal imaging and in the practical clinical application of variant heat patterns obtained from thermal imaging.

PURPOSE

Medical Infrared imaging (thermography) is a physiologic study that can provide an accurate and reproducible high resolution image of skin temperature. This image can be analyzed both qualitatively for thermovascular mapping and quantitatively for minute changes in skin heat emission. As with most physiologic studies, anatomic findings may not correlate and may not even be present.

The Guidelines contained herein will focus solely upon infrared imaging for Dental – Oral and Systemic Health studies.

INDICATIONS

Some of the common indications for performance of Dental-Oral and Systemic Health studies include:

- Evaluation or follow-up of patients with known or suspected temporal – mandibular dysfunction and other occlusive disorders.
- Evaluation or follow-up of patients with known or suspected oral-facial pain and myofascial conditions of the head and neck.
- Evaluation or follow-up of Inflammatory and infectious conditions related to the teeth, gingiva, and mouth.
- Evaluation or follow-up of caries and decay.
- Assessment of those systemic or organ specific disorders, or otherwise unclassified indications that have generally accepted skin surface thermal signatures including:
- cerebral vascular disease in the distribution of the ophthalmic artery
- thyroid disease
- hepatic overload or portal congestion
- peripheral arterial disease
- deep and superficial venous disorders
- inflammatory and obstructive lymphatic disorders
- pressure ulcers
- perforator and vascularization assessment
- varicocele
- dermatologic and immunologic conditions, including superficial skin vascular responses to environmental impacts such as mold or other allergens
- psychological manifestations that may impact skin surface temperature
- community health fever screening
- Pre-procedure assessment for planning of interventional therapeutics.
- Follow-up to determine technical adequacy of medical or surgical interventions, such as corrective dental measures, anesthetic injection, vascularization, environmental and liver detoxification, restoration of NEI imbalance, and emotional restructuring.
- Follow-up to detect improvement, progression or spread of disease, which may reflect change in condition.
- Mapping of the extent of vasomotor instability to guide generator identification.
- Mapping of the location of vasomotor instability for impairment rating purposes.
- Confirmation of diagnostic inclusion criteria for clinical diagnostic purposes.
- Confirmation of diagnostic inclusion criteria for research purposes.

CONTRAINDICATIONS AND LIMITATIONS

Contraindications Dental/Systemic Health Thermal Imaging include:

-Presence of casts, bandages or other technical factors that preclude the ability to expose skin to a temperature equilibration environment.

-An uncooperative patient.

GUIDELINE 1: PATIENT COMMUNICATION AND PREPARATION

1.1 The examining physician explains the dental/systemic health necessity for performing Dental-Oral and Systemic Health Infrared Dental/Systemic Health Imaging.

1.2 Responds to questions and concerns about any aspect of the examination.

1.3 Advises the patient about risk factors and symptoms of vasomotor instability and associated pathophysiology. Obtains informed consent either written or orally from the patient to proceed with Dental-Oral and Systemic Health Infrared Dental/Systemic Health Imaging.

1.4 Refers specific diagnostic, treatment or prognosis questions to the patient's physician.

1.5 Patient should not have contact with any object if that body part is being imaged. No clothing or garments should be worn over any region that is under study.

1.6 Shower or bathe the morning of the test to ensure that the skin is as clean as possible. Avoid hot water exposure to the skin for at least two hours prior to the test.

1.7 Avoid placing any material of any kind on the skin, such as any skin lotions, deodorants, preparations, moisturizers, liniments, makeup, hair spray, hair cream, topical analgesics, etc.

1.8 Nicotine and caffeine products should be discontinued 4 hours prior to imaging.

1.9 Wear loose clothing to the test; avoid anything binding against the skin; avoid support undergarments or pantyhose. Do not wear jewelry, preferably including rings if the hands are to be examined (exceptions are made for rings which cannot be removed or jewelry which the patient chooses not to remove for personal reasons).

1.10 To the extent possible discontinue the use of appliances such as braces, neoprene wraps, Ace bandages etc. on the day of testing.

1.11 Avoid massage, skeletal manipulation, acupuncture, physical therapy, occupational therapy, saunas, extended sun exposure, the use of TENS or electric muscle stimulation units. Electrodiagnostic testing should be avoided for 24 hours prior to imaging. Exceptions should be noted in the record.

1.12 Whenever possible steroids, sympathetic blockers, vasoactive medications, opiates and transdermal patches should be avoided for 24 hours prior to testing (12-16 hours minimum). Exceptions should always be recorded in the record.

1.13 When Cold Stress examinations are being performed, medications that are not medically necessary and that alter sympathetic function should be avoided for at least 24 hours prior to testing.

1.14 In the absence of extenuating circumstances, for original diagnostic studies sympathetic and neurolytic blocks should be avoided for 3 days prior to testing.

1.15 Peripheral nerve implants and spinal cord/dorsal column stimulators should be turned off 4 hours prior to testing.

GUIDELINE 2: PATIENT ASSESSMENT

Patient assessment should be performed before Dental-Oral and Systemic Health Infrared Imaging. This includes assessment of the patient's ability to tolerate the procedure and an evaluation of any contra-indications to the procedure.

2.1 Obtain a complete, pertinent history by interview and/or review of the patient's dental/medical record. A pertinent history includes:

a. Current dental/medical status, including dental history when applicable, pain and vasomotor instability.

b. Presence of any signs or symptoms of inflammation, allodynia or hyperalgesia in association with sudomotor, vasomotor, or other autonomic dysfunction. A symptom diagram should be completed (ie: pain, numbness, tingling etc).

c. Relevant risk factors for inflammation or vasomotor instability: prior history of RSD or CRPS, trauma, fracture, repetitive use, vibration syndrome, peripheral neuropathy, spinal pathology, radiculopathy, vasomotor headache,

rheumatic illness, cardiovascular disease, hypertension, diabetes, peripheral vascular disease, coagulopathy, birth control pill use, hypothyroidism or infection.

d. Pathology/Laboratory investigation values.

e. Current medication or therapies.

f. Results of other imaging, thermographic or vascular studies.

g. Results of prior dental, systemic health related, autonomic, sympathetic or vascular interventions.

h. Results of other relevant anatomic or physiologic studies (such as CT, MRI, Diagnostic Ultrasound, and electromyography).

2.2 Complete a limited, focused, detailed or extensive physical examination, which includes assessment of all structures under study. Dental-Oral, organ specific or system related regions of interest. Erythema, trophic changes, vasomotor or sudomotor changes, neurological symptoms, and possible pain generators should be documented.

GUIDELINE 3:
EXAMINATION GUIDELINES

3.1 Dental-Oral and Systemic Health Infrared Imaging measures and maps the degree and distribution of IR thermal emission. Asymmetric or localized IR emission variations of 1°C or greater can be indicative of pathology.

Dental-Oral and Systemic Health Infrared Imaging do not test structure, but rather correlates alterations in physiology. Therefore, when structural injury is suspected additional radiographic imaging or diagnostic studies may still need to be performed.

Due to the complex nature and etiology of conditions associated with skin temperature asymmetry patterns only those doctors trained in the proper techniques required to perform and interpret Infrared Dental-Oral and Systemic Health imaging should do so. When present, the pattern of asymmetry or localized variance should guide the treating physician in determining the source or generator of the abnormality. Both response to treatment and additional testing may still be required to complete this task.

3.2 The following minimum specifications should be incorporated in the design of infrared hardware and software systems. These specifications are intended to speak to the design of modern infrared imaging equipment that are considered commonplace today. They are not intended in any way reflect on systems used in the past.

• Emissivity set to 0.98 (human skin).

• Camera detector(s) response above 5 and below 14 microns.

• Preferred Absolute detector resolution of > 640 X 480 coupled with a suitable lens but no less than 320 X 240 sensors (Focal plane array system) coupled with lens and software or firmware innovations that meet sufficient spatial resolution and spot measurement requirements.

• Minimum measurable spot size is 2.1x2.0 mm at 40 cm distance (3x3 or 9 pixels).

• Spot resolution quality at 8 feet equivalent to ≤ 1 sq. mm at 40 cm from the detector(s).

• Spatial resolution quality at 8 feet equivalent to ≤ 2.6 mRad at 40 cm from the detector(s).

• Thermal sensitivity of ≤ ± 50 mK NETD @ 30 ºC.

• Ability to perform accurate quantitative differential temperature analysis with a precision of ≤ ± 0.05 ºC.

• Repeatability and precision of ≤ ±0.05 ºC detection of temperature difference. The repeatability of a differential measurement must be in the presence of +/- 3 NETD (6 sigma - 99.9% defect free mfg. standard).

• Changes in external ambient temperature to be strictly controlled at natural convection at or below 0.2 m/s.

• Thermal drift (caused by internal heating of equipment during normal operation or by changes in external ambient temperature) to be strictly controlled at natural convection at or below 0.2 m/s.

• Maintenance of detector uniformity and correction via calibration.

• Ability to capture images in hi-resolution color and grayscale.

• High-resolution image visual display for interpretation.

• Real time image focus and capture capability. While 10Hz, 20Hz, and 30Hz are capable of real time imaging faster capability is preferred (50Hz).

• Temperature range set to cover temperatures within the range of human emissions (20-45 ºC).

• Ability to archive images for future reference and image comparison at same patient positioning and distance from the camera.

• Software manipulation of the images should be maintained within strict parameters to insure that the original qualities of the images are not compromised

• Imaging software capable of identifying areas of calculations and locations for reporting.

Appropriate dental/systemic health infrared instrumentation, which includes real time display, electronic static image capture, storage, post capture annotation or hard copy documentation capabilities, should be utilized.

3.3 All studies should be performed in a laboratory where ambient temperature is controlled, free from drafts and where there is no exposure to ultraviolet rays that may result in heating. The imaging room should be comfortably cool to allow for pull-off of superficial heat which may produce artifact from the skin used. The IR imaging suite should maintain a steady state 20° to 25° (± 1°C) throughout testing. Unless a stress exam is intentionally being done no extraneous thermal stresses should exist.

3.4 Ventilation systems should be designed to avoid direct airflow onto the patient. The patient should be standing on a carpeted floor. Exposing the patient's feet may assist with equilibration, even with upper extremity examinations. Standard fluorescent lights are appropriate.

3.5 Since reproducibility of images obtained is important most studies should consist of more than one set of images. Infared studies should be performed in a steady state 20° C (± 1°C) environment and the patient should be allowed to equilibrate for 15-20 minutes prior to imaging. If Infrared studies are performed in an environment where the ambient image suite temperature is greater than 21° C, or if the thermologist desires to assess either sympathetic skin response or reproducibility and progressive change with increased exposure to the ambient temperature, then repeating the study two times at fifteen minute intervals should be performed.

3.6 A standard exam protocol for each region of interest should be used. This will frequently require multiple infrared image windows (including differing views) with different points of focus. Each point of focus should include anterior, posterior, medial, lateral, and inferior views for the head and neck. When the region of interest includes the torso oblique views should be included and depending upon the body part being studied lateral views may be omitted (for example oblique views have greater utility than lateral views in thyroid studies).

Contralateral and AP views should be equidistant and fill the image screen. When possible, it is recommended that the contralateral images should be captured in the same image. Additional images obtainment may be required for patients with specific, unique circumstances.

Whole Body studies done with the purpose of imaging the entire surface of the skin with minimal views, that do not provide evidence of reproducibility, or that do not follow the breadth and scope of this Guideline should be represented as either Dental or Systemic Health studies addressed by this Guideline.

3.7 Dental-Oral studies typically employ color palettes of no less than ten colors and are typically formatted at 1°C per color. Many laboratories have found it beneficial to use palettes with greater than ten colors however the 1°C per color format should be retained. Organ specific and Systemic Health studies may alternatively employ color, grey scale or reverse grey scale palettes that are formatted for eight colors during study acquisition. Each palette type is still typically calibrated across a range of 10°C however. Post-image processing may then be performed in varying palettes as deemed necessary by the interpreting thermologist.

3.8 The patient's physical and mental status is assessed and monitored during the examination, with modifications made to the procedure plan according to changes in the patient's clinical status during the procedure. Also, findings are analyzed throughout the course of the examination to assure that sufficient data is provided to the physician to direct patient management and render a diagnostic impression.

3.9 Evaluate the patient's physical and mental status prior to discharge. Additional discharge instructions may include recommendation to schedule follow up appointment with the attending physician, and to resume all medication or dental/medical treatment that may have been discontinued prior to the Dental/Systemic Health infrared study.

GUIDELINE 4:
REVIEW OF THE INFRARED THERMOGRAPHY EXAMINATION

4.1 The data acquired during Dental/Systemic health medical infrared examination should be reviewed to ensure that a complete and comprehensive evaluation has been performed and documented. Any exceptions to the routine examination protocol (i.e., study omissions or revisions) should be noted and reasons given.

4.2 Record all technical findings required to complete the final interpretation so that the measurements can be classified according to the laboratory diagnostic criteria (these criteria may be based on either published or internally generated data, but must be internally validated regardless of the source). It is recommended that published or internally generated diagnostic criteria should be validated for each thermography system used. When validating dental/systemic health infrared diagnostic criteria it is important to realize that equipment, operator and interpretation variability is inherent to this process.

4.3 Complete required laboratory documentation of the study.

4.4 Alert Dental/Medical Director or other responsible physician when immediate dental/medical attention is indicated, based on the infrared examination findings.

GUIDELINE 5:
PRESENTATION OF EXAM FINDINGS

5.1 Provide preliminary results as provided for by internal policy based on examination findings.

5.2 Present the record of diagnostic images and when applicable, explanations for sub-optimal examination findings to the interpreting physician for use in diagnosis and archival purposes.

5.3 Alert laboratory Dental/Medical Director or appropriate health care provider when immediate dental/medical attention is indicated.

GUIDELINE 6:
PREPARATION AND STORAGE OF EXAM FINDINGS

6.1 Images should be presented to the interpreting physician for use in analysis and archival purposes. Radiometric images in either radiometric image format or radiometric image convertible format such as JPEG or DICOM are acceptable.

6.2 The imaging clinic should adhere to all established federal and state regulations. Archiving of image data and the analysis/report are to be maintained for no less than seven years.

GUIDELINE 7:
EXAM TIME RECOMMENDATIONS

High quality and accurate results are fundamental elements of the Infrared Dental-Oral/Systemic study. A combination of direct and indirect exam components is the foundation for maximizing exam quality and accuracy. Recommended time: 30-60 minutes.

7.1 Indirect exam components include pre-exam procedures:

a) obtaining previous exam data, completing pre-exam paperwork,

b) exam room and equipment preparation and

c) patient assessment, history, and positioning (Guideline 1 & 2).

7.2 Post exam procedures include:

a) clean up consisting of compiling, processing, and reviewing data for preliminary and/or formal interpretation (Guidelines 3 and 4),

b) patient communication (Guideline 2),

c) examination charge and billing activities where appropriate.

7.3 Direct exam components include equipment optimization, patient positioning throughout the exam, and the actual hands-on examination process. (Guideline 3).

GUIDELINE 8:
REPORTING

8.1 A Medical Director's report should be prepared within 24 hours of the study. As part of their protocol imaging facilities should consider sending each patient a summary report within 30 days of the thermographic examination.

8.2 Report layout: The body of the Infrared Dental/Oral–Systemic Health Thermographic report should clearly state that laboratory procedures that follow a peer reviewed, internationally accepted guideline was utilized. The set of images obtained for study should be

documented. If a standard protocol for reading images is used then this should be stated as well.

8.3 Thermographic Findings should be documented and any abnormalities noted. Thermographic Impressions include classification according to an accepted naming system or summarization of the Thermographic Findings. When recognized patterns (thermal signatures) are seen due to the clustering of findings Thermographic Impressions may include the description of that pattern (for example: a sympathetic skin response asymmetry pattern is seen in the distribution of a branch of the trigeminal nerve or hyperthermia over the maxillary sinus) however care should be taken not to make any statements about clinical diagnosis in this section of the report.

8.4 Clinical Impressions are not to be included in the Thermographic Findings paragraph but rather in a separately identifiable paragraph that speaks to the generator or etiology of those findings. Any discussion that is clinically relevant should be reserved for this paragraph.

8.5 Dental/Oral findings should be reported as asymmetric skin response when done as a cold stress sympathetic skin response study. Findings include asymmetry of > 1 degree Centigrade in > 25% of the surface area of any individual region or constellation of regions and isolated localized hot or cold spots over specific anatomical areas.

8.6 Other findings that should be read include call outs related to individual Systemic Health related protocols. The following list includes call outs that are considered to be established thermal signatures that correlate with Systemic Health conditions.

- Cerebral vascular disease: reduced skin temperature (>2oC) or thermal asymmetry in the forehead supplied by branches of the ophthalmic artery, or in the vascular distribution of the orbital interior angle and medial superciliary areas of the eye. This specifically does not include the carotid artery.
- Thyroid disease: hot or cold spots over the thyroid gland; lobe thermal asymmetry; thyroid thermal gradient (>1oC) vs. surrounding tissue.
- Hepatic overload and portal congestion: diffuse “forked tongue” perforators on grey scale or diffuse spray brush dots on grey scale.
- Peripheral arterial disease: thermal gradient line consistent with peripheral artery (usually coldness) such as may be seen in a vasotomal or distal distribution.
- Deep and superficial venous disorders: tortuosity, cold or warm limbs.
- Inflammatory and obstructive lymphatic disorders: hot spots over inflamed lymph nodes, hyperthermia over lymphatic chains or in a characteristic “glow area”.
- Pressure ulcers: localized hyperthermia.
- Perforator and vascularization assessment: vessel visualization on color or grey scale, at rest and under cold stress to assess for greatest thermal capacity; maintenance of perfusion post graft; assessment of hypothermia in failing grafts and of hyperthermia in fistulas.
- Varicoele: increased temperature in a hemiscrotum.
- Dermatologic and immunologic conditions: hyperthermia over sites of infection, trauma, immune response (allergy), radiation, burns, or frostbite; thermal aberrations (primarily hyperthermia) that may be present with various skin cancers, psoriatic, and vasculitic disorders; hypothermic spots with leprosy. Superficial skin vascular responses to environmental impacts such as mold or other allergens: hypervascularity with or without closed loops on grey scale or hyperthermia on color palette.
- Psychological manifestations that may impact skin surface temperature including hyperventilation, anxiety, panic, depression, and drug addiction: systemic hypothermia with slow recovery to following rewarming; acute (stage fright, lie detector testing, etc) and chronic stress related conditions: extremity vasoconstriction or torso patchy hyperthermia on grey scale (as might be induced by peripheral nitrous oxide or vaso vagal manifestations such as blushing or perspiration).
- Community health fever screening: mean ear temperature >37.7 oC, or medial canthus temperature readings > 38 oC.

8.7 Findings not yet sufficiently recognized due to lack of consensus or as a result of having no basis in the medical literature include those related to visceral disease not already specified, paraspinal changes for immune system disease, external carotid findings for cerebral vascular, carotid, and coronary artery disease, non-vascular cardiac disease (such a mitral valve disease), metabolic diseases such as diabetes, and laboratory abnormalities. Any reference to medical conditions on a thermal image that may be misleading or construed as having been

diagnosed as a result of a shown thermal signature should be avoided.

If the interpreting thermologist feels a finding may have relevance also construes that it may within the scope of section 8.7 may report the finding as long as the following parameters are included in the report of findings: 1) the findings is described by using anatomical verbiage for description purposes of the findings location only, 2) it is clearly stated in the description of the finding that it is being correlated to viscera for localization and positioning purposes only, and 3) it is clearly stated that thermal imaging has not been substantiated and can only serve in an adjunctive capacity for these conditions.

GUIDELINE 9: CONTINUING PROFESSIONAL EDUCATION

Certification is considered the standard of practice for Infrared Dental/Systemic Health technology. It indicates an individual's competence to perform Dental/Systemic Health studies at the entry level. After achieving certification, all registered infrared technologists are expected to keep current with:

9.1 Advances in diagnosis and treatment of Dental-Oral and Systemic disorders as defined in this Guideline or that may have relevance to conditions under study.

9.2 Changes in infrared Dental-Oral and Systemic examination protocols or published laboratory diagnostic criteria.

9.3 Advances in infrared Dental-Oral and Systemic technology used for related examinations.

9.4 Advances in other technology used for Dental-Oral and Systemic infrared examination.

GUIDELINE 10: EMERGING TECHNOLOGIES

10.1 Technology is constantly being introduced that at times can challenge existing guidelines or that do not necessarily conform to currently accepted practices. These technologies can span the entire spectrum of sophistication and therefor require different adaptive responses. On one end of the spectrum there are innovations based upon generally accepted medical scientific methodology that have gained regulatory acceptance and on the other end there are technologies that are intended for personal use only or that have applications in non-medical fields but have not been accepted as suitable for medical practice.

10.2 Unless otherwise stated general industrial or personal thermal imaging cameras are not intended for use in Medical Thermology.

10.3 Technologies not otherwise covered in these Guidelines that employ methodologies, hardware, or protocols that have gained Federal Regulatory approval for Medical Thermology may become available however over time. In cases where these technologies are employed the body of the report should document which deviations occurred and why, and other components of the Guideline should still be followed.

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