Thermographic Assessment of Craniomandibular Disorders: Diagnostic Interpretation Versus Temperature Measurement Analysis

Barton M. Gratt, DDS
Professor and Chairman
Section of Oral Radiology
UCLA School of Dentistry
Los Angeles, California 90024-1668

Edward A. Sickles, MD
Professor and Chief
Breast Imaging Section
Department of Radiology
UCSF School of Medicine
San Francisco, California

John B. Ross, DDS
Chief
Temporomandibular Arthrotomographic Services
Section of Oral Radiology
UCLA School of Dentistry

Charles E. Wexler, MD
Medical Radiologist
Encino, California

Jeffrey A. Gornbein, PhD
Senior Statistician
Department of Biomathematics
UCLA School of Medicine

Correspondence to Dr Gratt

This study assessed electronic thermography as a diagnostic alternative for evaluation of temporomandibular disorders. The study populations consisted of 50 temporomandibular joint patients having internal derangement or osteoarthrosis and 30 normal temporomandibular joint subjects. An Agema 870 thermovision unit was used for analysis. Diagnostic evaluations by expert interpreters were made using standard procedures. Thermography measurements included mean absolute temperature measurements and right-left temperature differences for five anatomic zones and four spot areas. Statistical analysis of data included both linear discriminant analysis and classification-tree analysis. Results indicated that when differentiating between "abnormal" and "normal" temporomandibular joints using classification-tree analysis, correct classifications were made in 89% of the cases and observer diagnostic accuracy was 84%. When evaluating for specific diagnoses (eg, osteoarthrosis, internal derangement, or normal temporomandibular joint), correct classifications using classification-tree analysis were made in 73% of the cases and observer evaluation was correct in 59%. The three best temperature measures found were: (1) ΔT of the zone immediately overlying the temporomandibular joint; (2) the zone temperature of the half-face; and (3) the spot temperature anterior to the external auditory meatus. Additional studies are needed before thermographic diagnosis of craniomandibular disorders is accepted clinically.
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During the last 40 years, extensive research of the temperature characteristics of the human body has stimulated the evolution of "thermography," a generic title given to various methods of heat pattern identification and analysis. Clinical thermography predicates its value on the ability to picture the body's natural vascular heat emissions.

The normal thermogram demonstrates thermal symmetry. Central control of skin temperature affects both sides of the body uniformly and simultaneously, which results in symmetry of thermal patterns. In a study of facial (forehead), body (trunk), and extremity (limb) temperatures of normal subjects, the overall average temperature difference from side-to-side was only 0.24°C.[1]

Abnormal thermograms occur in response to vasomotor dysfunction. Such dysfunction cannot be demonstrated by conventional radiographic studies unless and until structural changes occur. Thermography, on the other hand, demonstrates one aspect of the physiology of the region, not the anatomy. Thermography reflects dysfunction of the small, unmyelinated, sympathetic C-type nerve fibers.[2] The presence of a significant temperature difference between corresponding areas of opposite sides of the body is highly suggestive of nerve impairment, as defective vasomotor mechanisms result in thermal asymmetry. In the acute stage of peripheral nerve injury, for example, the affected area has greater heat loss. As the nerve regenerates or denervation sensitivity of sympathetic nerve fibers develops, the affected area demonstrates a decreased heat loss.[3] Thermal asymmetry is the diagnostic hallmark of abnormality. In a study of 24 nerve injury patients, results indicated an average temperature difference of 1.55°C.[4]

The dental literature indicates that thermography is not useful in the assessment of periapical granuloma.[5] However, promising reports have been cited in the areas of neuralgias[6] and mandibular dysfunction (TMJ).[7–15] A recent pilot study[15] was designed to assess thermography in the diagnosis of internal derangements of the TMJ. Results from subjective blinded interpretations by two experts indicated a sensitivity of 86% and a specificity of 78% for the diagnosis of internal derangement of the TMJ vs normal subjects. Results from objective measurements of thermal symmetry of the TMJ region indicated that normal subjects demonstrated an 89.3% (±3.0%) level of perfect thermal symmetry, and internal derangement patients demonstrated only a 66.1% (±16.2%) level of facial thermal symmetry (a significant difference, $t = -4.89$, $P < .01$). It seems that electronic thermography (ET) may have promise as an assessment tool in identifying internal derangement of the TMJ. Also, recent publications have described in detail the thermal characteristics of the asymptomatic (normal) TMJ,[16] osteoarthrosis of the TMJ,[17] and internal derangement of the TMJ.[18]

It is the aim of this study to determine if ET is useful as a diagnostic alternative for the assessment of craniomandibular (TMJ) disorders, and, specifically, whether thermography as a diagnostic test *(1)* interpreted by thermography experts in blinded trials or *(2)* analyzed using objective temperature measurements will be able to distinguish between normal and abnormal subjects and between patients having internal derangement vs osteoarthrosis of the TMJ.

Materials and Methods

Population Studied

The target populations included consenting adult volunteers with internal derangement, osteoarthrosis, or a normal (asymptomatic) TMJ. These targeted populations were chosen for assessment by thermography because if electronic thermography cannot differentiate between these conditions then it is probably of no use in the diagnostic assessment of craniomandibular disorders.

Normal Subjects. Normal subjects were chosen from adult (over 20 years of age) patients, students, staff, and/or faculty at the university medical center. Thirty normal subjects were used (mean age of 27.0 years; male-to-female ratio of 1.3 to 1); the 30 subjects were selected to match the number of abnormal cases in the diagnostic studies (see below). All subjects completed a medical history questionnaire and those found to be acceptable received a clinical examination by a dentist.[19] For purposes of this study, a negative health history and a negative clinical examination established normal TMJ status. The subjects were not followed clinically over time and further tests were not conducted to support the "normal" diagnosis.

Abnormal Subjects. *Group 1 (Internal Derangement).* This group consisted of 30 mandibular dysfunction patients (mean age 36.9 years; female-to-male ratio 4:1) suspected of having an internal derangement (based upon history and clinical evaluation) who were examined using thermography. All 30 patients had pain and limited opening at the time of ET. Temporomandibular joint arthrotomographic examinations were conducted by an experienced arthrographer. The first 30 patients having a complete thermographic examination and positive arthrotomographic findings (Fig 1) (confirmed internal derangement by radiology report) were used in this study. It is believed that a positive arthrotomogram serves as the "gold standard" for the diagnosis of internal derangement of the TMJ.[20] Patients having equivocal arthrotomograms were not eligible for inclusion in this study.

Group 2 (Osteoarthrosis). This group consisted of 20 mandibular dysfunction patients (mean age 36.0 years; female-to-male ratio 4:1) having radiographically detected bony erosions on lateral and frontal tomographs interpreted by an experienced oral radiologist. All 20 patients reported intermittent pain while none had pain at the time of ET. Criteria for radiographic bone change included: *(1)* a bone erosion of at least 1.5 mm in greatest diameter; *(2)* a lesion located on

Fig 1 Lateral corrected arthrotomogram of the TMJ demonstrating an anteriorly displaced disc, leading to the classification of internal derangement.

Fig 2 Frontal tomograph of the mandibular condyle with the jaw in a protruded position. Arrow indicates the presence of a condylar bone erosion, leading to the classification of osteoarthrosis.

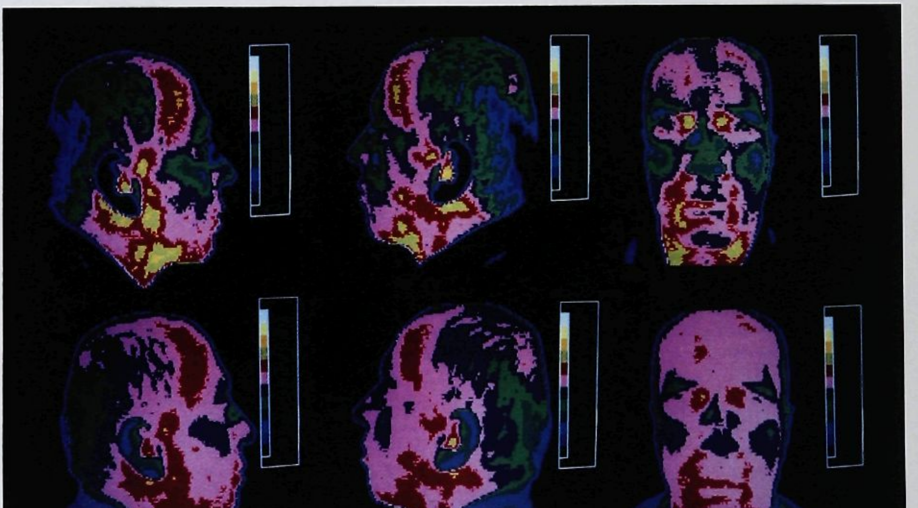

Fig 3 Example of complete thermographic series used in study. Frontal projection with right and left lateral thermographic projections taken at 0.5°C (top row) and 1.0°C (bottom row) imaging sensitivity.

the superolateral aspect of the condyle (not the superocentral or superomedial aspect) as seen on a frontal tomogram of the condyle; and (3) a radiographic interpretation specifically indicating osteoarthrosis (Fig 2).

Thermography Equipment

Thermography was conducted using an Agema 870 thermovision unit (including an infrared scanner, control unit, thermal image computer TIC-8000, MEDS 1.0 software, cables, stands, supports, and color monitor) coupled to a 35-mm camera with color print film. Room conditions for thermographic examinations included a draft-free environment (no windows, closed doors), temperature control (ranging from 20°C to 22°C), variable lighting, a patient-positioning chair, a head-positioning device, and a small hand-held electric fan.

Facial Imaging. All subjects were given prethermographic examination instructions according to the recommendations of the Academy of Neuro-Muscular Thermography.[21] Facial thermograms were taken on the 80 subjects at two imaging sensitivities (0.5°C and 1.0°C) using right and left lateral projections and frontal projections (Fig 3). Before the examination, each patient's face was cleared of hair (tied back), wiped with a damp cloth, and then air dried using a small electric fan. Men with long, extensive sideburns (including beards) were ineligible for participation in this study. Fifteen minutes were allowed for facial temperature equilibration; one series of six facial thermograms was then made and stored on computer disk, as well as photographed for diagnostic evaluation.

Subjective Diagnostic Assessment. Subjective diagnostic evaluations were made from color prints generated from the video monitor (Figs 4 to 6). Facial thermograms were mounted, coded, and randomly sorted. Diagnostic evaluations were performed independently, in single-blind fashion, by two expert thermographers. Both experts have taken or given formal courses in thermography (mainly of the body), published peer-reviewed articles on thermography, and have each performed more than 500 thermography examinations.

Two specific diagnostic questions were asked: *(1)* Is this patient normal or abnormal for a craniomandibular (TMJ) disorder; and *(2)* If abnormal, does the patient have *(a)* osteoarthrosis or *(b)* internal derangement of a TMJ. Examiners responded with three levels of decision: "Yes," "No," or, if necessary, "I Can't Tell."

All examiners used previously published thermal image criteria to assess for craniomandibular disorders.[16-18] Examiners were not given any clinical information that could be correlated with symptoms. Results were recorded and then assessed using correct classification rates (sensitivity, specificity, and accuracy).

Computer-Aided Thermal Measurements. These measurements were made on the facial thermograms of the 80 subjects, using right and left lateral projections at 0.1°C accuracy (with a measurement error of ±0.1°C). Analysis was made from electronically generated image measurements of digitized color thermograms, using a TIC-8000 computer and color monitor. Existing computer programs allowed for individual mapping of TMJ areas (electronically measured) (Fig 7), absolute temperature measurements of thermal points in the TMJ region (Fig 8), mean temperature measurements of the TMJ region and around the TMJ, and mirror-imaged comparisons of individual TMJs (or regions) as a function of temperature difference and location.

Computer-generated measurements were made of the three study groups (normal, internal derangement, osteoarthrosis). Differences between groups were assessed for each measurement individually and for the entire set with *(1)* linear discriminant analysis and *(2)* classification-tree analysis. Classifications made using these objective methods were compared to our subjective (expert observer) classifications .

Statistical Methods

Temperature measurements were made on the right and left sides of the face for the five anatomic zones (zones 1 to 5, Fig 7) and at four thermal, TMJ-related spots (spots 1 to 4, Fig 8). The differences were computed (ΔT) from these 18 thermal measurements (9 on each side) to make a set of 27 potentially discriminating variables to use in the computer-aided analysis.

Linear Discriminant Analysis

These 27 variables were used in a linear discriminant analysis employing all 80 persons. The linear discriminant analysis was carried out with SAS PROC DISCRIM and BMDP program 7M. The prior probability of group membership was assumed equal for all three groups.

Objective classifications using linear discriminant analysis provided "objective" estimates of sensitivity and specificity (or % correctly classified). Each case was classified according to the so-called "jackknife" method. That is, the discrimi-

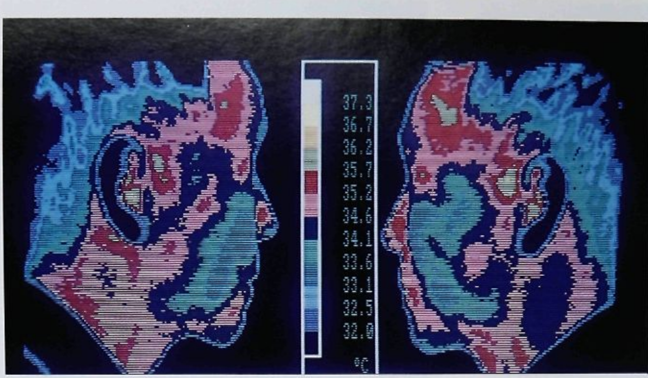

Fig 4 Lateral facial thermogram of a 30-year-old female subject taken at 0.5°C sensitivity. Note pattern of colors seen in the TMJ region. Subject is classified as having a normal TMJ thermal pattern.[15]

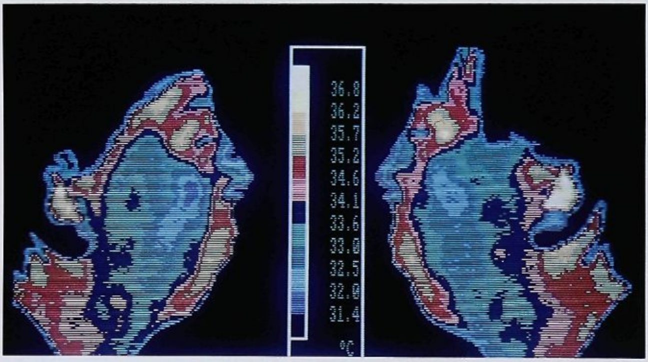

Fig 5 Lateral facial thermogram of a 52-year-old female patient having internal derangement of the left TMJ.[16] Note the change in thermal patterns compared to the normal patterns shown in Fig 4.

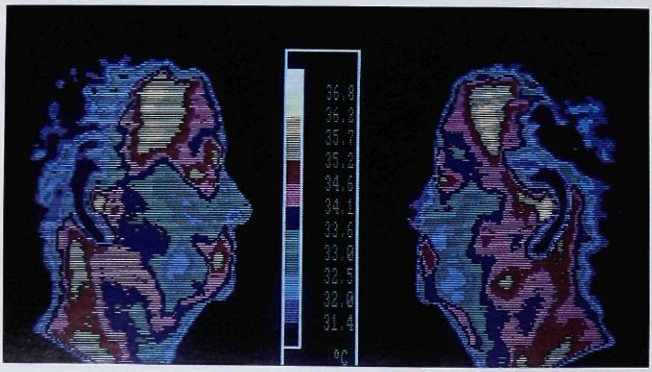

Fig 6 Lateral facial thermogram of a 75-year-old female patient having osteoarthrosis of the left TMJ.[17] Note the change in thermal patterns compared to the normal patterns shown in Fig 4.

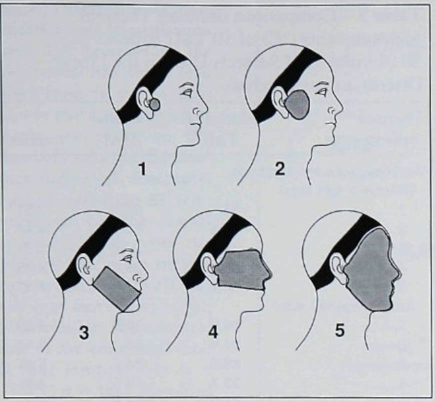

Fig 7 Five TMJ-related anatomic zones measured in this study.

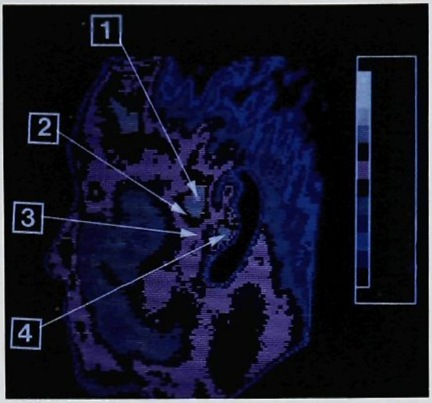

Fig 8 Lateral TMJ thermogram demonstrating the four regions (measured at 0.1°C sensitivity) imaged at 0.5°C sensitivity: region 1 = central TMJ region; region 2 = red ring around region 1; region 3 = pink field between regions 2 and 4; and region 4 = central EAM.

nant rule (probability of the observation being part of a given group) was computed excluding the observation being classified. In this way a single observation is not simultaneously used both to compute the classification rule and to evaluate it. This method reduces the tendency to underestimate the misclassification probability (overestimate the sensitivity and specificity) and provides a degree of cross-validation.

Classification-Tree Analysis

In addition to linear discriminant methods, classification-tree analysis (CT) was performed.[22] Since it was not feasible to use all 27 measures in a CT analysis, the leading five measures obtained from univariate analysis, linear discriminant analysis, and clinical judgment were used to carry out the analysis. The five thermal variables used were: *(1)* ΔT of the small zone over the TMJ (zone 1); *(2)* absolute mean temperature of the half-face (zone 5); *(3)* ΔT of the point just anterior to the external auditory meatus (EAM) (point 3); *(4)* absolute temperature of the point immediately over the EAM (point 4); and *(5)* ΔT of the point immediately over the TMJ (point 1).

The classification-tree analysis was also subjected to cross-validation. A tree was built using 90% of the data (training set) and homogeneity was assessed using the remaining 10% (validation set) in the terminal nodes. This was done 10 times so that all observations were used both in the training and validation sets. The final classification tree reported is a single tree that was present in all 10 cross-validation runs. Thus, both the linear discriminant analysis and the classification-tree analyses were subjected to some form of cross-validation.

Results

Table 1 shows the results of the subjective blinded thermographic evaluation by two expert interpreters of the first diagnostic question (Is this patient normal or abnormal for a craniomandibular [TMJ] disorder). Overall diagnostic accuracy of both experts was found to be 84%. Sensitivity (true-positive rate) was 80% and specificity (true-negative rate) was 88%. Each of the examiners rated 5% of the cases as "I Can't Tell." (Also of note is that Examiner 1 obtained higher scores than Examiner 2.)

Table 2 shows the results for the second diagnostic question (Does the patient have *[a]* an internal derangement or *[b]* osteoarthrosis of an individual TMJ). The overall correct classification rate for internal derangement patients was 47%, for osteoarthrosis patients 30%, and for normal subjects 90%. The two examiners rated 7% to 8% of the cases as "I Can't Tell." (Examiner 1 produced

Table 1 Correct Classification Rates* (Sensitivity, Specificity, and Accuracy) of 50 Abnormal TMJ Patients and 30 Normal TMJ Subjects After Subjective Evaluation

Evaluator	Abnormal TMJ patient (sensitivity)	Normal TMJ subject (specificity)	Overall (accuracy)
Examiner 1†	40/46 (87%)	28/30 (93%)	68/76 (89%)
Examiner 2†	35/48 (73%)	23/28 (82%)	58/76 (76%)
Average	80%	88%	84%

*All standard errors are between 4% and 6%.
† = Examiners 1 and 2 both rated four cases (4/80, 5%) as "Can't Tell."

Table 2 Correct Classification Rates* of 30 Patients With Internal Derangement of the TMJ, 20 Patients With Osteoarthrosis of the TMJ, and 30 Normal TMJ Subjects After Subjective Evaluation

	Diagnostic Category		
Evaluator	Internal derangement	Osteoarthrosis	Normal
Examiner 1†	24/45 (53%)	10/25 (40%)	54/60 (90%)
Examiner 2§	17/43 (40%)	5/25 (20%)	54/60 (90%)
Average	47%	30%	90%

*All standard errors are between 4% and 6%.
† = Examiner 1 rated 10 joint images (10/140 or 7%) as "Can't Tell."
§ = Examiner 2 rated 11 joint images (11/140 or 8%) as "Can't Tell."

scores equal or higher to those of Examiner 2.)

Comparisons of mean facial temperature measurements are shown in Table 3. Significant differences (*t* test scores greater than 2.05, at $P = .05$) were found comparing 27 normal vs abnormal measurements. All of the 5 anatomic zones, 4 of the 5 spot measurements, 5 of the 5 anatomic zone ΔT temperatures, and 4 of the 4 spot temperature measurements all demonstrated statistically significant differences. The single most discriminating measurement was that of the small anatomic zone over the TMJ (ΔT of anatomic zone 1). Average ΔT of anatomic zone 1 on 30 normal subjects was found to be 0.1°C, and the same average ΔT on 50 abnormal patients was found to be 0.4°C. The second most important variable was found to be the temperature of the entire half-face (anatomic zone 5), which was on average 34.9°C in normal subjects vs 34.2°C in abnormal patients. The third most important variable was found to be ΔT of spot no. 3 (the difference in absolute temperature comparing the temperature of a point [spot] between the TMJ and the EAM). The ΔT for spot measurement 3 was found to average 0.0°C in normal subjects vs 0.15°C in abnormal patients. These three independent thermal variables (ΔT of anatomic zone 1, temperature of the entire half-face, and ΔT of spot no. 3) were used to estimate correct classification rates via linear discriminant and classification-tree analysis.

Results of applying classification-tree analysis to the selected thermal measurements are shown in Fig 9. The threshold values found to be most important included: first, the ΔT of the mean tem-

Table 3 Comparison of Mean Thermal Measurements (°C) of 50 TMJ Patients vs 30 Normal TMJ Subjects Used in the Linear Discrimination Analysis

Thermal measurement	Abnormal TMJ	Normal TMJ	*t* values*
Anatomic zone temperatures			
(Affected/right side)			
1	35.1	35.5	3.51
2	34.5	35.1	4.44
3	34.0	34.8	5.31
4	33.8	34.6	4.38
5	34.2	34.9	5.40§
(Unaffected/left side)			
1	34.9	35.5	4.39
2	34.4	35.1	5.10
3	33.9	34.7	5.41
4	33.7	34.5	4.61
5	34.0	34.8	5.41
Spot temperatures			
(Affected/right side)			
1	35.7	36.1	4.11
2	35.2	35.5	2.87
3	34.7	35.0	2.75
4	36.3	36.4	1.26
(Unaffected/left side)			
1	35.3	36.1	5.63
2	35.0	35.5	3.78
3	34.5	35.0	3.74
4	36.1	36.5	2.58
Δ anatomic zone temperatures			
1	.41	.12	40.49†
2	.29	.12	20.53
3	.24	.14	2.45
4	.25	.15	2.50
5	.21	.12	2.72
Δ spot temperatures			
1	.34	.00	3.98
2	.17	.01	2.32
3	.15	−.01	2.76¶
4	.14	−.07	2.48

*Statistically significant, *t* test value at >2.05, for $P = .05$; and highly statistically significant, *t* test value at >2.65, for $P = .01$.
† = Most significant thermal variable (thermal measure no. 1).
§ = Second most significant independent thermal variable (thermal measure no. 2).
¶ = Third most significant independent thermal variable (thermal measure no. 3).

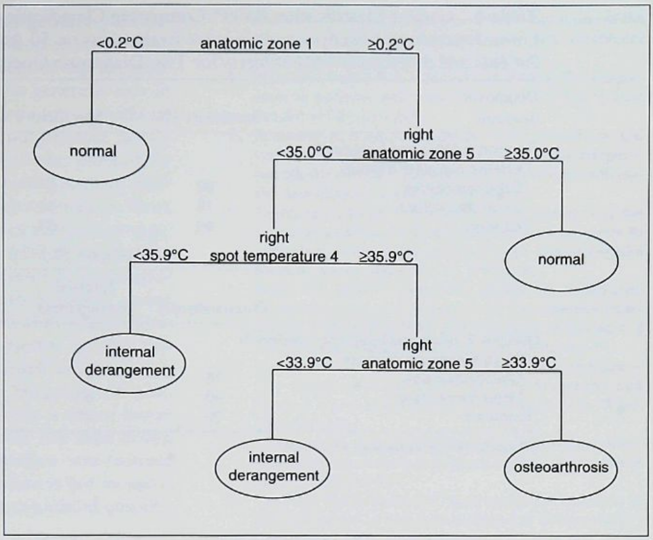

Fig 9 Diagram of the classification rule (classification tree). The figure shows the hierarchical rule and is read down from the top. A decision to move right or left is made according to the threshold value for the measure indicated. Example: First, consider the ΔT temperature of the small anatomic zone over the TMJ. If the value of this measurement is > 0.2°C the rule is to move to the right. Next consider the temperature of the entire half-face. If that temperature is > 35.0°C it is then classified as normal, etc.

perature of the small anatomic zone over the TMJ (ΔT anatomic zone 1), which was < 0.2°C; next, the mean temperature of the entire half-face (right side used for consistency; anatomic zone 5), which was < 35.0°C; next, spot temperature measurement no. 4 (the temperature of a single point [spot] over the EAM), which was < 35.9°C (right side used for consistency); and finally, the mean temperature of the entire half-face (anatomic zone 5), which was < 33.9°C.

The results of correct classification rates (sensitivity, specificity, accuracy) comparing the classification-tree method of analysis vs the linear discriminant method of analysis vs the two expert examiners are shown in Table 4. The results indicated that when distinguishing between abnormal and normal TMJ patients (question 1), the classification-tree analysis yielded 89% correct classification, the linear discriminant analysis yielded 83% correct classification, and the two examiners yielded 84% correct classification. Standard errors were between 4% and 6%.

Results of correct classification rates among three groups of patients (osteoarthrosis, internal derangement, and normal; question 2) are also shown in Table 4. The classification-tree method of analysis demonstrated the highest correct classification rates: 75% correct for osteoarthrosis, 57% correct for internal derangements, and 87% correct for normal subjects. The overall correct classification rate for the classification-tree method of analysis was 73% correct. The linear discriminant method of analysis demonstrated lower correct classification rates.

Discussion

Results of this study showed that ET can select normal TMJ subjects from abnormal TMJ patients at an 89% correct classification rate using objective thermal measurements and classification-tree analysis. Similarly, an 84% correct classification rate was found by subjective observer examination of the facial thermograms, and a 83% correct classification rate was found by linear discriminant analysis. This suggests that ET has promise as an objective screening examination in the detection of patients with TMJ disorders. If this conclusion is validated, ET may allow more detailed, expensive, or invasive procedures to be conducted less frequently.

While promising results were noted when using ET to select abnormal from normal TMJ patients, ET was relatively weak in identifying specific TMJ abnormalities (normal vs osteoarthrosis vs internal derangement). Using classification-tree analysis, only a 73% correct classification rate was found;

Table 4 Correct Classification Rates* Comparing Classification Tree Analysis vs Linear Discriminant Analysis vs Subjective Evaluations on 50 Abnormal TMJ Patients and 30 Normal TMJ Subjects for Two Diagnostic Questions

Diagnostic question	Sensitivity (%)	Specificity (%)	Overall accuracy (%)
Question 1: (Abnormal by patient?)			
Objective computer analyses			
Classification-tree	90	87	89
Linear discriminant	78	88	83
Examiners	80	88	84

	Accuracy (%)			
	Osteoarthrosis	Internal derangement	Normal	% overall correct
Question 2: (Abnormal by specific condition?)				
Objective computer analyses				
Classification-tree	75	57	87	73
Linear discriminant	40	67	80	65
Examiners	30	47	90	59

*All standard errors are between 4% and 6%.

linear discriminant analysis and subjective observer interpretation were even less accurate. The authors believe that to be clinically meaningful in the evaluation of specific TMJ conditions, the classification rate should be at least 80% correct. Thus, ET may not be useful for obtaining an initial TMJ diagnosis (MRI, arthrotomography, CT, conventional tomography, etc, are still necessary).

The scientific basis for thermal change in patients with TMJ disorders is unknown.[23] It can, however, be speculated that the changes seen on thermograms of TMJ patients are due to a vascular reaction to hyperalgesia (hyperalgesia being defined as pain evoked by nonnoxious stimuli, exaggerated pain magnitude, and abnormally prolonged aftersensation of pain). Speculating further, this vascular reaction may be triggered by neurosecretion from hyperactive sensitized C nociceptors.[2] The temperature change then might be a consequence of microcirculatory changes of the synovial membrane or nearby muscles. It also may be that acute problems (eg, acute TMJ trauma) may result in increased temperature, and chronic problems (such as osteoarthrosis with pain of more than 4 months' duration) may result in decreased TMJ temperatures. Just as the cause of the degenerative TMJ changes in osteoarthrosis is unknown, so is the cause of ET-recorded TMJ temperature changes. It may be that ET cannot distinguish between internal derangement and osteoarthrosis because the cause of the pain is the same even though the diseases are different. More research is needed in the basic mechanisms underlying TMJ pain disorders.

Throughout this study Examiner 1 consistently scored higher correct classification rates than Examiner 2. In a detailed interview and analysis of the examiners following their blinded evaluations, it was found that the two examiners had slightly different approaches to their method of interpretation of the TMJ thermograms. Examiner 2's approach to interpretation was found to rely more heavily on the 1.0°C images while Examiner 1 relied more heavily on the 0.5°C images. It appears that the higher sensitivity image (0.5°C) allowed for higher detection sensitivity without sacrificing detection specificity. However, until more research is conducted on the relative utility of 0.5°C vs 1.0°C sensitivity thermograms, both types of thermographic imaging still should be considered as standard technique.

Generally speaking, ET imaging techniques of the TMJ were easy to perform during this study. Only 4% to 8% of the images were rated as "I Can't Tell" by the two examiners. In all cases this was the result of hair obscuring the TMJ region or the immediate surrounding area. Women with prominent side burns that were not long enough to be tied up or back would on occasion have this hair obscure the thermal image. More careful attention to hair management would have eliminated this image artifact. The use of a cloth head band is easy for patients to use and very effective in tying back the hair.

Slight variations in size and geometry of the thermogram did not cause problems in image analysis or interpretation. Adjustment of the temperature range (thermal focusing) was generally easy to conduct. Female subjects with minor amounts of make-up on eyes and lips did not produce nondiagnostic images, but make-up on other parts of the face needed to be and was removed prior to thermal imaging. Minor ear infections (such as those occurring on earlobes adjacent to pierced earrings) and small facial blemishes (pimples or small razor nicks) were noted and charted prior to thermography to determine whether they might cause increased temperature prior and during facial thermal imaging. No cases were rejected for this reason. In one rejected case (not used in this study), sunburn was found to create imaging problems. Any patients or subjects with even a minor recent sunburn (less than 10 days) were not used in this study. The thermographic procedure was received well by all patients. The procedure is not invasive, painful, or unpleasant, and it is completed quickly.

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Resumen

Evaluaciones termográficas de los desórdenes craneo-mandibulares: Interpretación diagnóstica versus análisis de la temperatura

Este estudio evaluó la termografía electrónica como una alternativa diagnóstica para evaluacíon de los desórdenes temporomandibulares (DTM). La problación consistó de 30 personas cuyas articulaciones temporomandibbulares (ATM) estaban sanas y 50 pacientes con problemas de tales como malfuncionamientos internos y osteoartrosis. Para el análisis se utilizó una unidad de termovisión Agema 870. Las evaluaciones diagnósticas realizadas por intérpretes expertos fueron efectuadas de acuerdo a procedimientos comunes y corrientes. Las medidas termográficas incluyeron promedios de temperatura absoluta y diferencias de temperatura derecha-izquierda en cinco zonas anatómicas y cuatro sitios. El análisis ramificado de clasificación. Los resultados indicaron que cuando se efectuó la diferenciación, se hicieron clasificaciones correctas en el 89% de los casos y la exactitud diagnóstica del observador fue del 84%. Cuando se evaluaron diagnósticos especificos (como en el caso de osteoartrosis, malfuncionamientos internos o ATM normales), se realizaron clasificaciones correctas utilizando el análisis ramificado de classificación en el 73% de los casos y la evaluación del observador fue correcta en el 59% de los casos. Las tres mejores medidas de temperatura encontradas fueron: (1) ΔT de la zona localizada inmediatamente encima de ATM; (2) la temperatura de la zona de la mitad de la cara; y (3) la temperatura del sitio anterior al meato auditorio externo. Se necesitan mas estudios antes de que el diagnóstico termográfico de los desórdenes craneomandibulares sea aceptado clínicamente.

Zusammenfassung

Thermographische Befunde bei Myoarthropathien des Kausystems (MAP): Diagnostische Interpretation versus Temperatur-Analyse

Diese Studie untersuchte die elektronische Thermographie als diagnostische Alternative für die Erfassung von MAP. Die Testgruppe umfasste 50 Patienten mit Diskusverlagerung oder Arthrose des Kiefergelenkes, die Kontrollgruppe 30 Individuen mit gesunden Kiefergelenken. Ein Agema 870 Thermovision-Gerät wurde zur Analyse verwendet. Die Diagnostik wurde von erfahrenen Untersuchern nach bewährter Methode durchgeführt. Die thermographischen Messungen beinhalteten die mittlere absolute Temperatur, die rechts-links Temperaturdifferenz für fünf bestimmte anatomische Zonen und vier Spots. Eine linear diskriminierende Analyse und eine "classification tree" Analyse wurden durchgeführt. In 89% der Fälle konnte bei Verwendung der "classification tree" Analyse eine korrekte Klassifikation in die Kategorien "normales" und "abnormales" Kiefergelenk vorgenommen werden. Die diagnostische Genauigkeit der Untersucher betrug 84%. Wenn eine spezifische Diagnose gemacht werden sollte, z. B. Arthrose, Diskusverlagerung oder normales Kiefergelenk, so gelang mit der gleichen Analyse die richtige Diagnose in 73% der Fälle. Die diagnostische Genauigkeit der Untersucher lag jetzt bei 59%. Die drei besten Temperaturmessungen konnten an folgenden Stellen vorgenommen werden: 1) Temperaturdifferenz der Zonen unmittelbar über dem Kiefergelenk, 2) die Zonentemperatur einer ganzen Gesichtshälfte und 3) punktuell vor dem äusseren Gehörgang. Zusätzliche Studien sind nötig, bevor die thermographische Diagnose von MAP klinisch zur Anwendung gelangen kann.