ISSN-1560-604X
Thermology international

Thermology international

Volume 9 (1999)
Number 1 (January)

formerly European Journal of Thermology

Published by the

Ludwig Boltzmann Research Institute
for Physical Diagnostics
Austrian Society of Thermology

THERMOLOGY INTERNATIONAL
(formerly EUROPEAN JOURNAL OF THERMOLOGY)

Volume 9 (1999) **Number 1 (January)**

Published by the
Ludwig Boltzmann Research Institute for Physical Diagnostics and the Austrian Society of Thermology

Organ of the American Academy of Thermology
Organ of the European Association of Thermology
Organ der Deutschen Gesellschaft für Thermologie
Organ der Österreichischen Gesellschaft für Thermologie
Organ of the Thermology Society of Great Britain

Instruktionen für Autoren

Manuskripte müssen dem Schriftleiter zugesandt werden und dürfen noch nicht veröffentlicht sein.

Die Manuskripte von Übersichts- und Originalarbeiten werden 2 unabhängigen Begutachtern vorgelegt, die über Annahme oder Annahme nach Änderung des Manuskriptes entscheiden.

Mit der Annahme der Arbeit gehen alle Rechte an den Herausgeber über.

Verantwortlicher Schriftleiter:

Dr. Kurt Ammer

Ludwig Boltzmann Forschungsstelle
für Physikalische Diagnostik,
Hanuschkrankenhaus, Heinrich Collinstraße30
A-1140 Wien, Österreich,
Tel: (43 1) 914-97-01 Fax: (43 1) 914-92-64
e-mail: KAmmer1950@aol.com

Publiziert werden:

Editorials
Übersichten
Originalien
Berichte über interessante Publikationen aus dem Gebiet Thermologie
Mitteilungen der Amerikanischen Akademie für Thermologie; der Britischen Gesellschaft für Thermologie; der Deutschen Gesellschaft für Thermologie; der Europäischen Assoziation für Thermologie und Mitteilungen der Österreichischen Gesellschaft für Thermologie
Veranstaltungshinweise

Manuskripte sollen mit den Empfehlu terantionalen Komittees der Herausgeber von Medizinischen Zeitschriften (ICMJE) (1,2) im Einklang stehen.Es ist auf eine klare Gliederung der Beiträge vorzugsweise in der Form:Einleitung, Methode, Ergebnisse,Diskussion, Danksagung, Literatur, zu achten. Jeder Arbeit ist eine Kurzfassung in Deutsch und Englisch voranzustellen. Bis zu 5 Schlüsselwörter sollen den Inhalt der Arbeit zusätzlich charakterisieren.

Tabellen und Abbildungen sollen gesondert dem Manuskript beigelegt werden. Legenden werden auf einem Extrablatt beigegeben.

Die Einreichung der Arbeit auf Diskette unter Angabe des verwendeten Systems ist möglich und erwünscht. Ein Ausdruck des Textes ist der Diskette beizulegen.

Literaturangaben sind auf einem gesonderten Blatt erbeten und sind in der Reihenfolge aufzulisten, in der sie im Text genannt werden..Die Literaturzitate werden durchnumeriert; im Text werden nur die entsprechenden Nummern angegeben. Die nachstehende Beispiele basieren of them Format der Amerikanischen Nationalbibliothek für Medizin im Index Medicus. (Eine komplette Liste von Beispielen bei 1).

a.) Zeitschriftenzitate

Namen der Verfasser, Vorname(n) (abgekürzt)(die ersten 6 Autoren müssen angeführt werden, mehr als 6 Autoren werden mit "et al" angegeben), vollständiger Titel der Arbeit, abgekürzter Titel der Zeitschrift, Jahr, Band, Seitenzahlen.

Luther B, Kreyer I, Dobi I. Die Anus-praeter-Thermographie als Methode zur Früherkennung vaskulärer Komplikationen nach Dünndarmtransplantation. ThermoMed 1990: 6: 115-17.

b.) Buchzitate

Name der Verfasser, Vorname(n) (abgekürzt), vollständiger Titel der Arbeit, Herausgeber, Titel des Buches, Ort,Verlag, Jahr, Seitenzahlen.

Gautherie M, Haehnel P, Walter JM, KeithL. Long-Term assessment of Breast Cancer Risk by Liquid Crystal Thermal Imaging. In: Gautherie M, Albert E; editors. Biomedical Thermology. New York: Alan R.Liss Publ;1982. 279-301.

Von Text und Abbildungen werden den Autoren Andrucke zur Korrektur zugesandt. Jeder Autor erhält 20 Sonderdrucke seiner Arbeit kostenlos.

ch f. für
- "Thermology international" erscheint 4 mal jährlich. Ein Jahresabonnement kostet öS 460,- ein Einzelheft öS 140- .plus Porto (ATS 60.-pro Heft außerhalb Österreichs)

Für Mitglieder der Österreichischen Gesellschaft für Thermologie, der Deutschen Gesellschaft für Thermologie und der Amerikanischen Akademie für Thermologie ist die Zeitschrift im Mitgliedsbeitrag inkludiert.

Literatur

(1)International Committeof Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. Can. Med Assoc J 1997;156;270-7.

(2) International Committeof Medical Journal Editors. Additional statements from the International Committeof Medical Journal Editors. Can. Med Assoc J 1997;156; 571-4.

Uhlen-Verlag,
Moßbacherg.29,A-1 140 Wien
Thermology international
ISSN-1056-604X

Inhaltsverzeichnis (CONTENTS)

Editorial

Originalien (ORIGINAL ARTICLES)

Berichte (REPORTS)

Mitteilungen der Deutschen Gesellschaft für Thermologie
(INFORMATIONS OF THE GERMAN SOCIETY OF THERMOLOGY)

News in Thermology (THERMOLOGISCHE NACHRICHTEN)

Veranstaltungen (MEETINGS)

Instructions for authors

Manuscripts should be mailed to the editor and should not be submitted elsewhere. All manuscripts (i.e. reviews and original articles) will be read by two independent reviewers. With the acceptance of the paper all copyrights are transfered to the publisher.

Editor in Chief

Dr. Kurt Ammer

Ludwig Boltzmann Forschungsstelle für
Physikalische Diagnostik, Hanuschkrankenhaus
Heinrich Collinstraße 30 A-1140 Wien, Österreich,
Phone: (43 1) 914-97-01 Fax:(43 1) 914-92-64
Personal e-mail:KAmmer1950@aol.com

We publish

Editorials

Reviews

Original articles

Reports on thermological publications of interest

Announcements from

The American Academy of Thermology,
The Austrian Society of Thermology
The German Society of Thermology
The Thermology Society of Great Britain
The European Association of Thermology

Information and abstracts
from conferences and symposia

Manuscripts should follow the recommendations of the International Committe of Medical Journal editors (ICMJE) (1) and should be organized as follows: Introduction, methods, results, discussion, acknowledgements, references. A short abstract in English and, if possible, German (trans- lation will be offered) should head the manuscript. Following the abstract, up to 5 key-words should characterize the paper.

Tables, Figures and Legends for illustrations should appear each on an extra sheet of paper.

Submission on computer discs with name of the used system is encouraged. A print of the disc content should be enclosed.

References should be numbered consecutively in the order in which they are first mentioned in the text. Identify references in text, tables, and legends by Arabic numerals in parentheses. Use the style of the examples below which are based on the formats used by the US National Library of Medicine in Index Medicus (complete list of examples on (1)).

Standard journal article (List the first six authors followed by “et al” if the number exceeds 6).

> Luther B, Kreyer I, Dobi I. Die Anus-praeter-Thermographie als Methode zur Früherkennung vaskulärer Komplikationen nach Dünndarm-transplantation. ThermoMed 1990; 6: 115-7.

Chapter in a book

> Gautherie M, HaehnelP, Walter JM, Keith L. Long-Term assessment of Breast Cancer Risk by Liquid Crystal Thermal Imaging. In: Gautherie M, Albert E, editors. Biomedical Thermology. New York Alan R.Liss Publ; 1982. p. 279-301.

Before publication proof prints will be mailed to the main author for corrections. Each author will receive 20 free copies of the reprint.

The journal”Thermology international” (formerly “European Journal of Thermology") is published four times/year. Annual Subscription rate is ATS 460.-, a single copy costs ATS 140.- plus mailing costs (ATS 60/copy; outside Austria).

The journal is supplied free of charge to members of the American Academy of Thermology, the Austrian Society of Thermology and also to members of the German Society of Thermology.

References:

(1)International Committeof Medical Journal Editors. Uniform requirements for manuscripts submitted to biomedical journals. Can. Med Assoc J 1997;156;270-7.

(2) International Committeof Medical Journal Editors. Additional statements from the International Committeof Medical Journal Editors. Can. Med Assoc J 1997;156; 571-4.

Uhlen-Verlag,
Moßbacherg.29, A-1140 Wien
Thermology international
ISSN-1560-604X

Finally “Thermology international”

K.Ammer

General Secretary of the European Association of Thermology,
President of the Austrian Society of Thermology, Editor of “Thermology international”,
Ludwig Boltzmann Research Institute for Physical Diagnostics (Director: O.Rathkolb, M.D), Vienna

In the 9th year of publication, our Journal has changed its name for the third time. “Thermologie Österreich”, derived from an un-officially registered series of proceedings of the thermological symposia of the Austrian Society of Thermology and the Ludwig Boltzmann Research Institute for Physical Diagnostics. Both instituitions continued to edit the journal as it became the “European Journal of Thermology” in 1997. This change of the name was necessary, because not only the European Association of Thermology, the British and the Austrian Society of Thermology used it as their publication organ, the German Society of Thermology also changed to our journal last year. This year the American Academy of Thermology decided to join this publication, which is now the representive publishing organ of six thermologic associations, supporting the scientists of two continents in their effort to develop and promote the diagnostic and therapeutic use of heat. Other national societies in any part of the world will be welcomed to join us and thus build a strong source of references for thermology.

While there is no question that “Thermology international” was the final and necessary change of name, it is also the programme for the future. The international community of experts in thermal imaging must stay and work together to provide a climate where infra red imaging, supported by new, more accurate measuring equipment than in earlier days, will be an accepted technique in medicine and biology. In industry and technical science thermal imaging has already found such a position. This can be easely recognized by the increasing, and still growing number of meetings, conferences and papers in the technical field.

As the editor of this journal I will continue to establish and support the co-operation between users in both the technical and in the medical field to induce a better understanding of the word thermology in both disciplines. Submissions of scientific papers from both fields would be the best means to achieve this goal.

Acceptance of the journal in one of the major medical databases, is not yet been achieved. However this will also help to etablish thermology as an accepted discipline in the world of science. We now adopt the recommendations of the International Committee of Medical Journal editors (ICMJE), as included in the “Instructions for Authors” which should be also helpful to bring “Thermology international” into medical database listings.

Spatial Resolution of New Thermal Imaging Systems

E.F.J.Ring, J.M. Dicks

Dpt of Clinical Measurement, Royal National Hospital for Rheumatic Diseases, Bath Bal 1 RL UK

Summary

A new generation of infra red thermal imaging systems are now available for medical thermography. The focal plane array detectors used do not require mechanical scanning. and where cooling ls used, this is achieved electronically rather than with liquid nitrogen, which has been commonly used over the past 40 years. This study describes a simple laboratory test target experiment which demonstrates the radical improvements in spatial resolution now achieved with the new systyms. The images were recorded at standard fields of view to match the common clinical use. These are 5ox50cm², 20x20cm², and minimal focal distance for the lens used. The systems compared were Agema 570, lnframetrics Thermacam, Nikon Laird and an older Agema 782. single element mechanical scanner in use since the 1980's.

Key words: spatial resolution, focal plane array

Räumliche Auflösung moderner wärmeabbildender Systeme

Nun stehen auch für die Medizinische Thermographie moderne wärmeabbildende Systeme zur Verfügung. Die verwendeten Focal Plane Array -Detektoren bedürfen keines mechanischen Scan-Mechanismus und eine eventuell notwendige Kühlung wird eher elektronisch als durch flüssigen Stickstoff erzielt, der üblicherweise in den letzten 40 Jahren dazu verwendet wurde. Die vorliegende Untersuchung beschreibt ein einfaches Experiment, das mit Hilfe eines Messphantoms den bedeutenden Fortschritt in der räumlichen Auflösung der jetzt aktuellen Systeme aufzeigt. Die Bilder wurden unter standardisierten Aufnahmebedingungen und für Bildgrößen, die dem klinischen Einsatz entsprechen, angefertigt. Dies entspricht Flächen von 50 x 50 cm², 20 x 20 cm² sowie der Fläche bei der minimalen Brennweite der verwendeten Optik. Eine Agema 570, eine Inframetrics Thermacam sowie eine Nikon Laird wurden untereinander und mit einer Agema 782 verglichen, die als scannender Einzelelement-Detektor seit 1980 in Gebrauch steht.

Schlüsselwörter: räumliche Auflösung, focal plane array

Introduction

For four decades, infra red thermal imaging in medicine has been dependent on a single element detector usually indium antimonide or cadmium rnercury telluride. Most of these systems used a single element, with optical- mechanical scanning to build up the image. Cooling the detector was necessary to obtain sufficient thermal sensitivity by liquid nitrogen, or more latterly by electronic cooling devices such as the 'sterling" cooler. With all rnechanical scanning systems, there is a balance to be made between speed of imaging and spatial resolution. The slower the scan, the higher the resolution and vice versa. Attempts to improve speed and retain spatial resolution were made with multi-element de- tectors. One of the most successful of these was the Sprite detector. This was based on a strip of cadmium mercury telluride, which could be stacked in multiple arrays. Signal Processing In The Element allowed the signal to travel faster than the noise, resulting in very high resolutlon imaging. This detector developed in the UK has been used in many industrial and

aviation systems where high speed and fine detail are required in the infra red band (1).

Current technology has advanced, and due to military research and technology transfer programs it is now possible to use focal plane arrays with increasing array sizes resulting in high speed high resolution images, The need for mechanical scanning has been obviated, and in some systems, uncooled detectors can now give satisfactory images for medical applications. Sometimes referred to as staring arrays, these detectors make use of the latest Charge coupled detector technology, and produce video or digital signals which are easily processed by modern image processing computers.

In an early study of spatial resolution (2), a series of thermograms from a heated bar target displaying bars & spaces of thickness ranging from 2mm - l0mm was recorded using different thermal imaging systems available during the 1970's in the UK. These scanners operating at speeds from 1 frame per second to 16 frames per second were tested at three distances to record fixed area fields of view. The results showed great differences between the systems and in some cases, barrelling distortion of the image. The loss of spatial resolution with increased distance was marked. For this reason the author has continued to use clinical protocols which depend on multiple images taken close to the patient rather then thermograms recorded from large areas of the body.

This paper describes a more modern application of the same practical test, using a heated plate etched with a bar and space pattern to display dots or lines from 1 mm to 5 mm using modern focal plane arrey cameras. The results were compared to an Agema 780 series IR system, which is still commonly used in medical applications of thermal imaging, but uses a single element detector which is mechanically scanned to create the image.

The heated target plate (fig.1) was fixed on a level base with metal rnarkers either side which could be positioned at equal distances from the side of the target. Following the early study (1982) fields of view (FOV) of 20 x 20 cms, and 50 x 50 cms square were used. In addition, the minimum focus possible for the lens used was studied. (3) These field areas are typically used in clinical thermography to image a hand

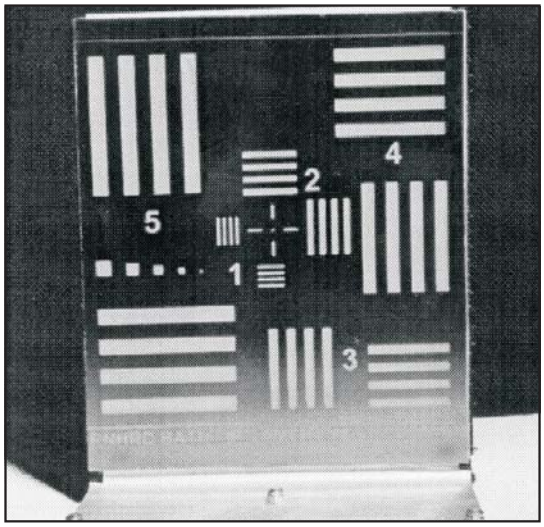


Figure 1
The metal target showing lines and spots of different sizes 1-5 mm

or foot, pair of hands and section of the trunk or limbs respectively. The metal edge markers were warmed so that the thermal camera could be positioned at the correct distance for the lens in use to just show the side markers at the edge of the image. lt is important to note that these distances were determined for the image on the primary direct (analogue) monitor in line before digitisation. Video grabber systems for computer processing are often not exactly set to the proportions of the image generated by the camera. lt is also possible to make a comparison of the spatial resolution before and after digitisation, which will be affected by the number of pixels used in the digitising system of the computer. The images were captured through our own special software package BTHERM on a Hewlett Packard Pentium Netserver LD Pro (4). The frame grabber was set to capture the AGEMA 782 images at 128x128, Agema 570 and lnfra- metrics images were set to 256x266, while the Nikon was set at 512x512.

Finally, the target was positioned in the centre and four corners of the image for each system and field size to detect possible distortion at the limits of the image. The procedure is shown in figure 2.

The different specifications of the cameras included in this study are shown in table 1.

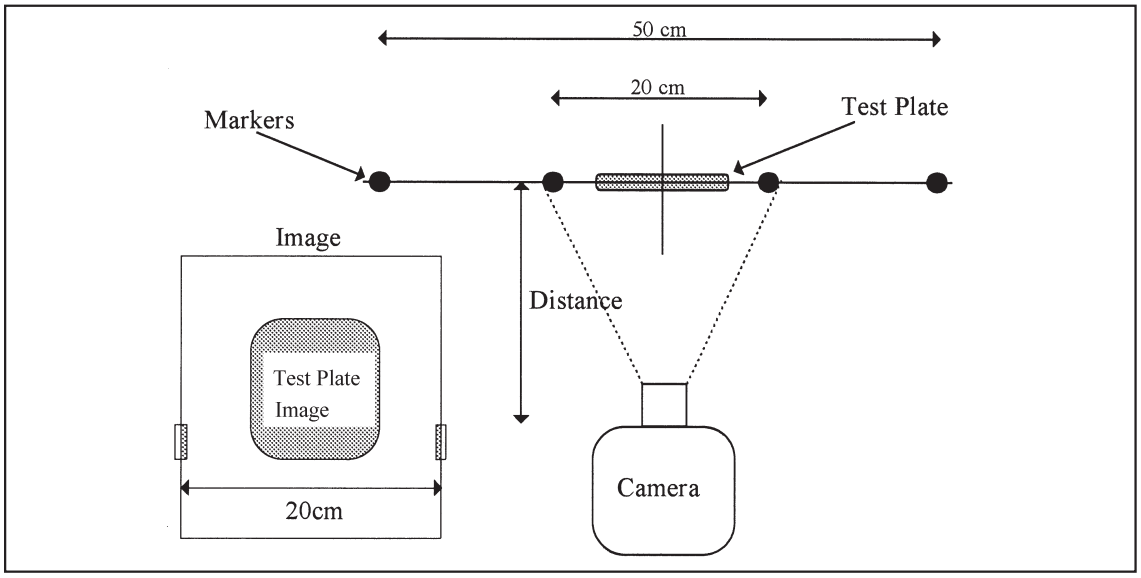


Figure 2
Schematic diagram of the IR camera and test target with edge markers

Table 1
Specifications of the cameras included in this study

	Agema 782 M (1982)	Agema 570	Inframetrics Thermacam	Nikon Laird 3A
detector	Single element Indium Antirnonide scan 12.6 fps	Platinum Silicide Uncooled Micro-Bolometer 320x240	Platinum Silicide 256x256 FPA 65536 pixels	Platinum Silicide 811 x608 FPA 41 0,000 pixels

Results

The images of the target for each of the distances / field size FOV are shown in figs 3 - 5. The close up image made with the Inframetrics system indicates some barrelling when the lens was used in close up (fig 6). Reflection from the lens was also shown to affect the image with the very close up pictures taken with the Inframetrics, although this effect was not shown in the other thermograms. The tests on geometric distortion across the image were otherwise all even, an example of the Nikon Laird at 50x50cms FOV is shown in figure 7.

The NIKON System, the largest instrument 48cms long including the lens and total weight of 10 Kg had the highest number of pixels per image and showed even resolution of the 2mm bars both vertical and horizontal at the largest field of view in this test. (Fig 10).

In general the greatly improved resolution of the newer focal plane arrey systyms is evident.

Bar Resolution

The target pattern is designed to provide bars in both the vertical and horizontal, and in spot sizes from 1-5 mm . Comparison of the horizontal and vertical bars resolved are shown in figs 8, 9 and 10. For minimum focus, 20x20cms FOV and 50x50cms FOV respectively.

Spot resolution

The resolution of a single spot was adaquate for 1 mm with the Agema 570, Inframetrics 16° lens and the Nikon Laird Systems. These results are shown in figure 11 and 12, which also demonstrate that the older AGEMA 782 was only able to resolve 5mm for both FOV's under the conditions of this laboratory test.

Discussion

All optical and electronic imaging systems have limits for performance. lt is a physical principal that spatial resolution of an optical system will decrease with increasing distance between the camera and the target. Some of the

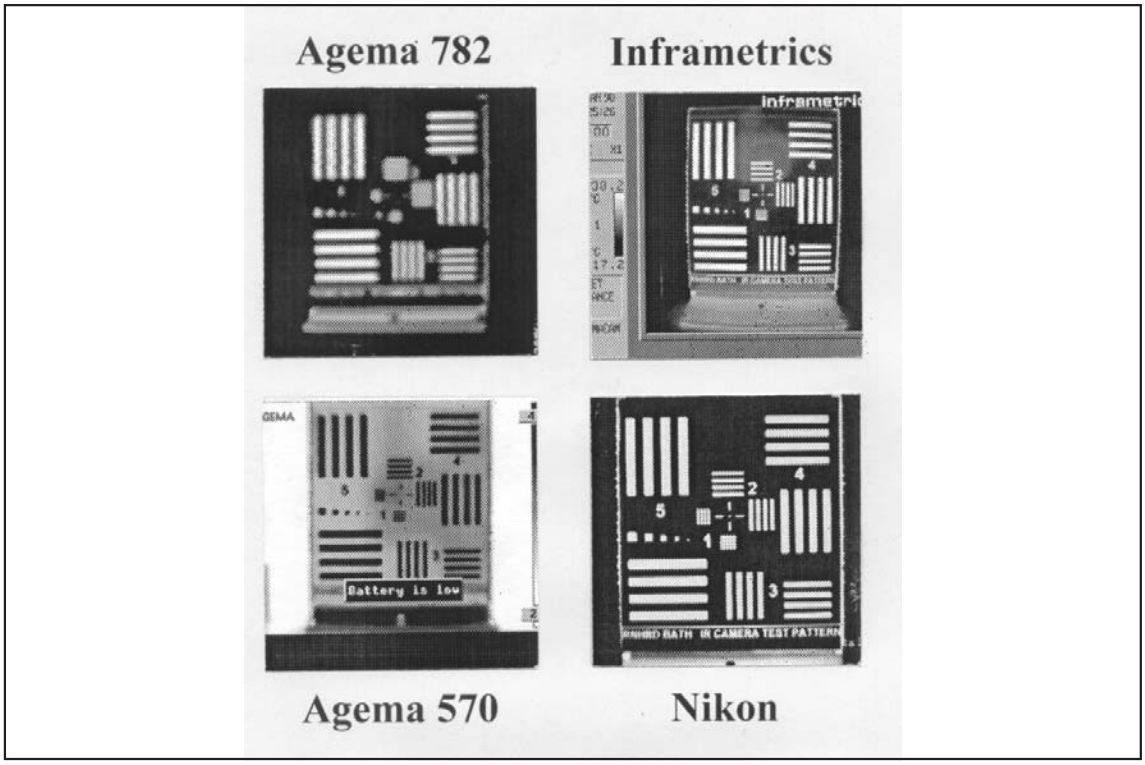


Figure 3
Four IR cameras to compare the target images at 20x20 cms field of view

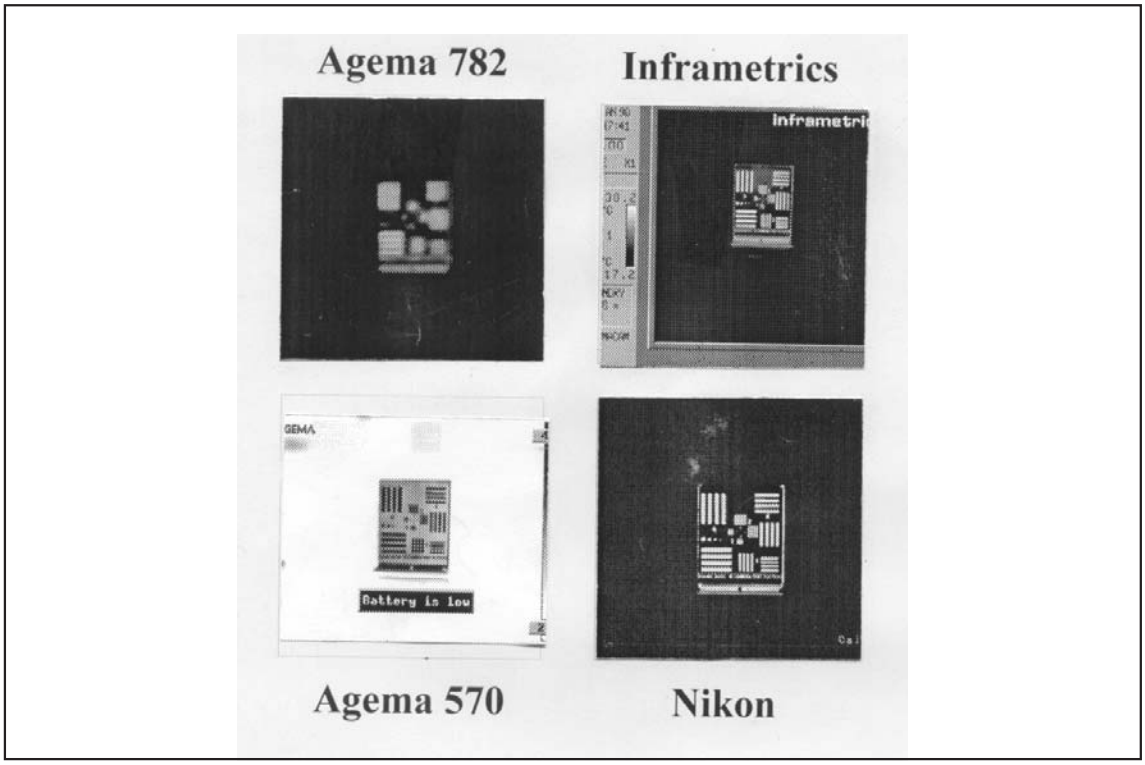


Figure 4
Four IR cameras to compare the target images at 50x50 cms field of view

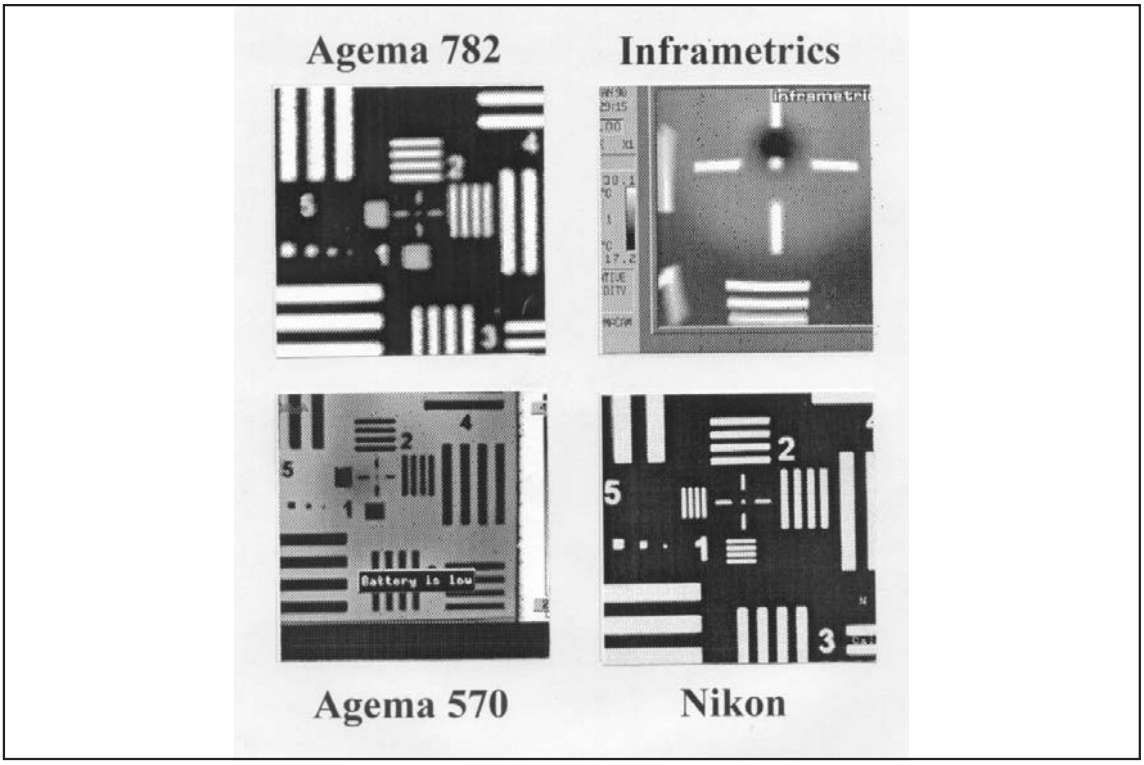


Figure 5
Four IR cameras to compare the target images at minimum focus

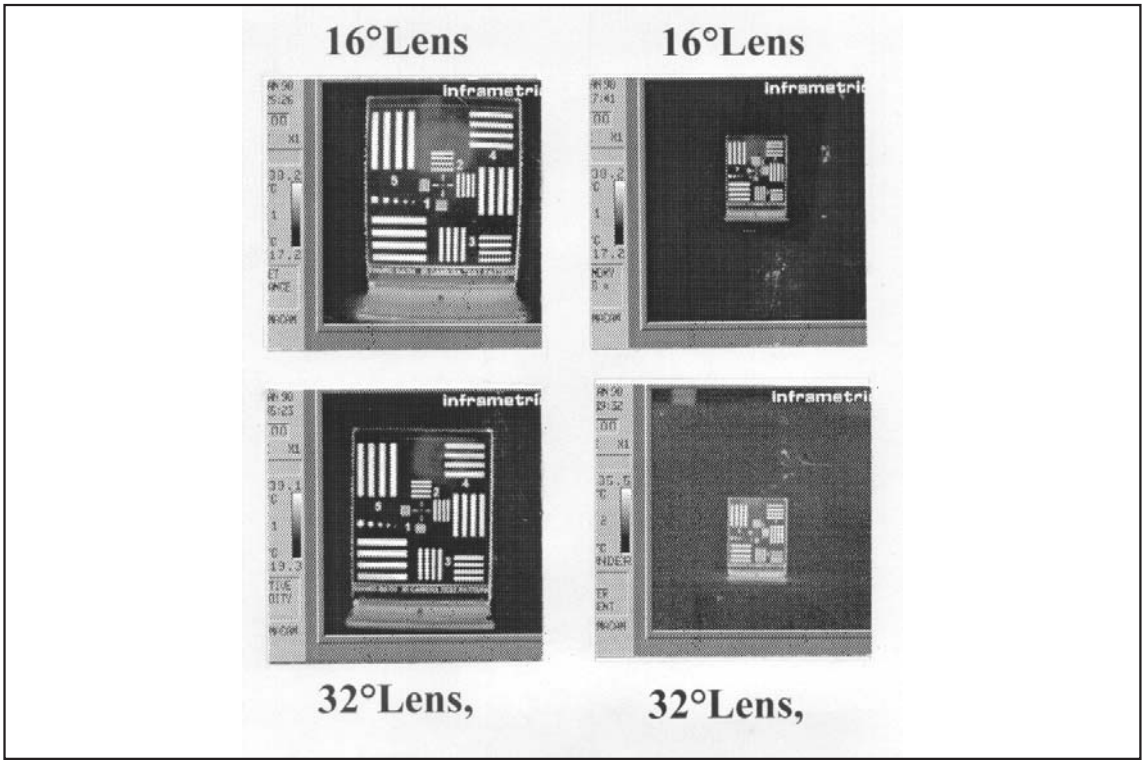


Figure 6
Comparison of the inframetrics camera at 20x20 cms (left column) and 50x50cms (right column) using both 16° ans 32°lenses.

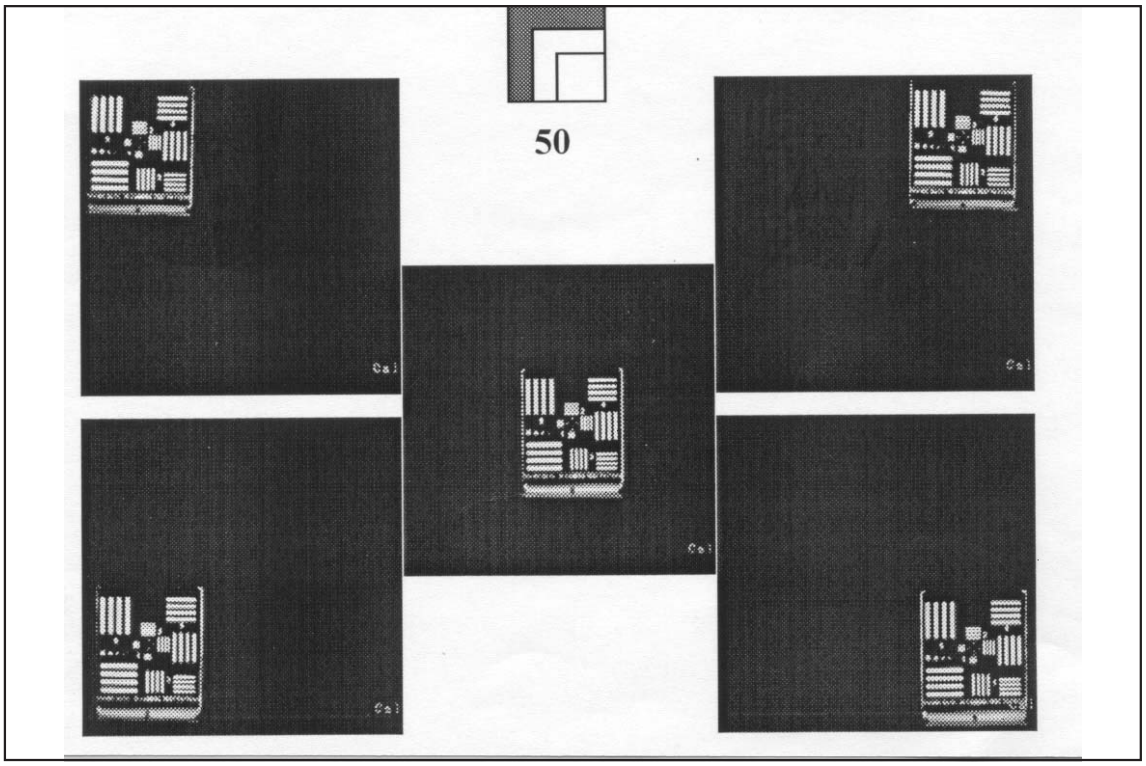


Figure 7
Using the 50x50 cms field of view, the target is imaged at the centre and four corners. No loss of detail was detectable due to non-uniformity (Nikon Laird)

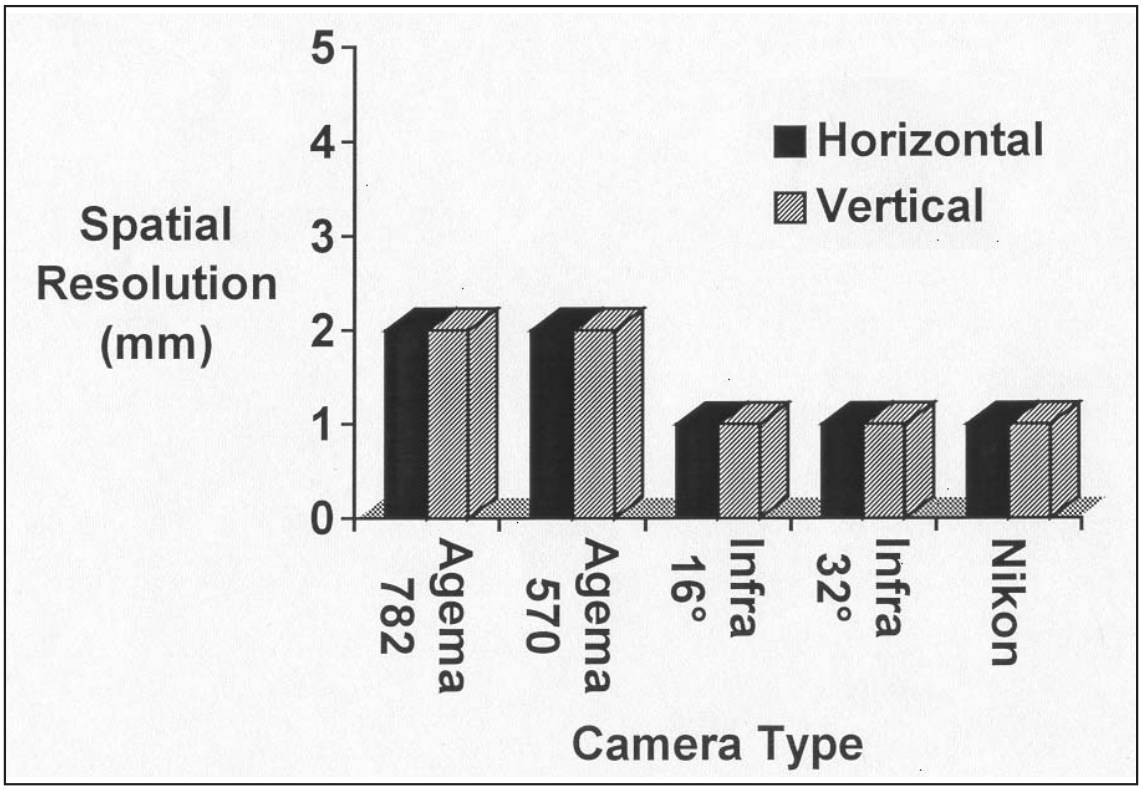


Figure 8
Histogram of the thinnest bars resolved by each system at the minimum focus.

new FPA camersa provide a zoom facility. This enlarges the image of the object, but is purely an electronic magnification, which results in loss of image definition depending on the number of pixels forming the original image. The process of digitisation can result in some resolution loss, although the digitisation programme cannot provide more pixels than are originally found in the image. For this reason, the NIKON images were the only ones which could be usefully digitised at 512x512, the upper limit of the particular board in the computer used for this study.

This study confirms that many of the mechanical systems in use for medical thermography still need to be kept at minimal distances from the patient to obtain the best results, Furthermore, where repeated examinations are made to quantify changes due to disease or therapy, these distances should be standardised, to avoid variations in the spatial resolution of the thermograms. This study was performed with an Aluminium plate which had had the pattern printed on by the etch photo resist method. This target was constructed by Dr Plassmann at the University of Glamorgan, UK. to follow the larger target used in 1980, but providing spot and lines down to 1 mm in size and thickness. The emissivity of the plate differs from that of human skin, but adequately serves for an inter-machine comparison.

It has been proposed that spatial resolution of 2mm may be necessary to adequately resolve the thermal pattern arising from a superficial blood vessel. There are, however many different factors which contribute to the thermal image of a blood vessel, including size of the vessel, temperature of the blood within the vessel, depth and type of skin tissues between the vessel and the skin surface. The temperature distribution above a subcutaneous vessel will generally fall off from a maximum just above the vessel. However, there is also a thermal interaction between neighbouring vessels so that the resulting emission of heat may be maximal

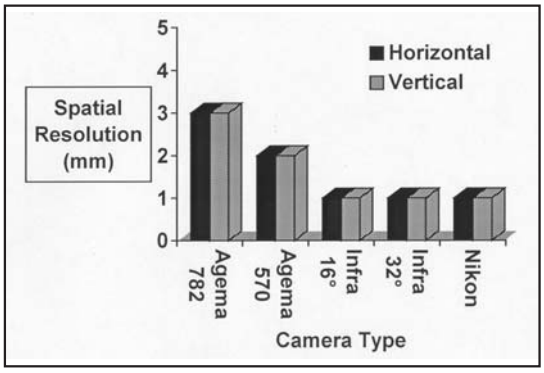


Figure 9
Histogram of the thinnest bars resolved by each system at 20x20cms FOV

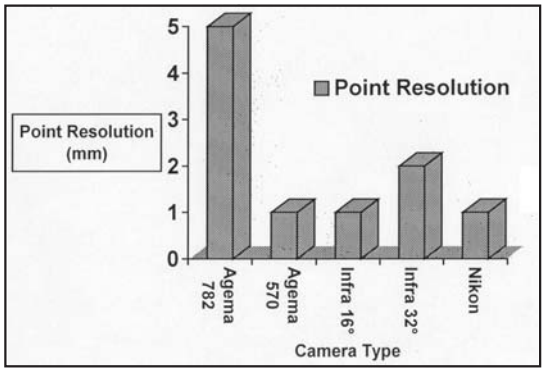


Figure 11
Histogram of the smallest spot resolved by each system at 20x20cms FOV

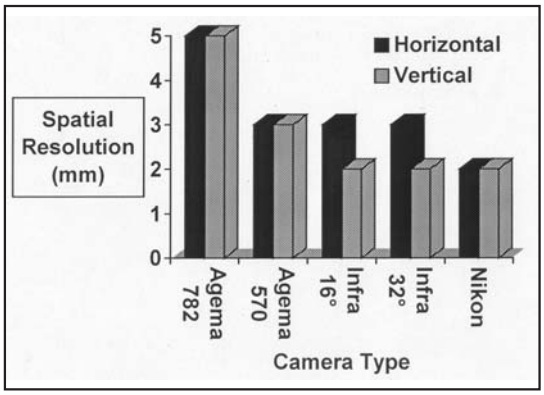


Figure 10
Histogram of the thinnest bars resolved by each system at 50x50cms FOV

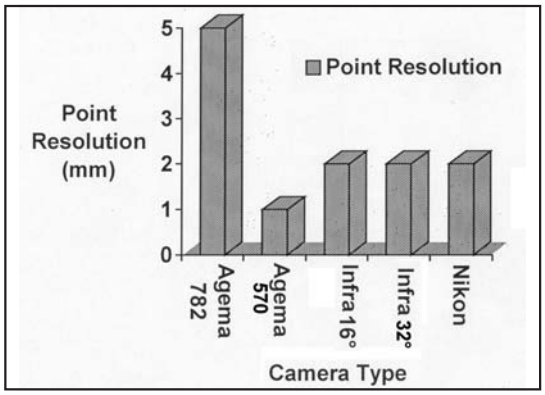


Figure 12
Histogram of the smallest spot resolved by each system at 50x50cms FOV

over the vessel, but could develop maxima between the vessels. (5.)

IR. lmaging uses radiative heat from the skin surface and cannot “see” deeper structures. However, conduction of heat to the surface can be high in certain anatomic locations and if the surrounding tissues are cooler, an apparently sharp image results.

The study shows that the modern focal plane array detector systerns offer much higher spatial resolution than the earlier systems, so that the critical attention to distance may become loss important for quantitative studies. lt is also possible to image larger areas of the body within the 2-3rnm spatial resolution test than was previously possible. Human skin and vascular structures are not as sharply defined as a man-made target. Heat patterns over vascular structures is likely to follow a gaussian distribution, and do not provide the sharp edges created by a printed target. Nevertheless, clinical studies show microvascular skin structures more readily with the FPA systems than that normally achieved with the single element imagers, In some clinical applications the thermal changes can be both gross (>l°C) and diffuse, so that these improved images may be of limited benefit. However, when any region of the body studied by thermography contains vascular features, the improved resolution is of special value. The faster, real time video like signal is also easily processed using modem signal processing techniques. These all contribute to the desired goal of the medical thermographer, to have good technology and lower cost. This must have a favourable in- fluence on the potential expansion of applications and clinical use of this high performance technique.

References

1.Ring EFJ Video -Thermal Imaging, In: Engel J-M, Flesch U. Stüttgen G, editors. Thermological Methods., Weinheim: VCH; 1985. p.101 - 11.

2. RingEFJ. Quality Control in lnfra red Thermography. In: Ring EFJ.; Phillips B., editors. Recent Advances in MedicalThermology NewYork: PlenumPress, 1984. p.185 -94

3.Ring EF, Dicks J Elvins DM. High Resolution Infrared Imaging. Europ. J.f Thermol 1998; 8(2): 71.

4.Plassmann P Ring EFJ. An Open System for the Acquisition and Evaluation of Medical Thermological Images, Eur. J.Thermol 1997; 7(4):216-20.

5..Branemark Pl, Nilsson K. Thermographic & Microvascular Studien of the Peripheral Circulation. In:. von Voss H.; Leiden T. editors. Medical Thermography. Basel: Karger; 1969. P.130-142.

Address of the Author

Prof.Francis Ring

Dpt of Clinical Measurement,
Royal National Hospital for Rheumatic Diseases,
Bath BA l 1 RL UK

(Manuscript received on 8.1.1999, accepted on 18.1.1999)

The Thermal Image of Patients Suffering from Carpal Tunnel Syndrome with a Distal Latency Higher Than 6.0 msec

K. Ammer, B.Engelbert, P.Melnizky, T.Schartelmüller

Ludwig Boltzmann Research Institute for Physical Diagnostics (Director: O.Rathkolb, MD), Vienna, Austria

Summary

Objective of this study was to determine, if patients with a distal latency of the median nerve higher than 6.0 msec present with a hyperthermic pattern. The thermal patterns were defined by the difference of the mean skin temperature of the median nerve innervated area minus the mean skin temperature of the ulnar nerve innervated area. A difference of at least 0,5 degrees was defined as a hyperthermic pattern. A warmer ulnar area of 0,5 degrees or more was defined as a hypothermic pattern.

Thermograms were taken of 52 hands in 26 subjects before and every 5 minutes after a moderate cold stress test (CST) for 20 minutes. In all subjects a nerve conduction test of the median nerve was performed bilaterally. Distal latency was higher than 6 msec in 15 hands (severe carpal tunnel syndrome =sC), between 4,4 and 5,8 msec in 17 hands (moderate carpal tunnel syndrome=mC), and the remaining 20 hands showed the distal latency in the normal range.

Before CST, 5 sC-hands presented with a hyperthermic and 3 hands with a hypothermic pattern. 7 hands with mC showed a warm median nerve area, 2 hands with presented with a warmer ulnar nerve area. A hyperthermic pattern was seen 4 times in the 20 healthy controls and 3 times a warmer ulnar skin area was found in this group.

10 minutes after CST 5 hands with sC, 5 hands with mC and 4 control hands showed a hyperthermic pattern. A hypothermic pattern was found in 2 sC hand, 5 mC and 4 control hands. At this time, the temperature of the median nerve area had recovered to baseline readings in 14 controls, 10 mC hands and 6 sC hands. 20 minutes after CST, the median nerve temperature has not recovered in 5 controls, 3 sC and 2 mC hands.

In conclusion, there is a slight increase of the frequency of hyperthermic patterns in patients with severe carpal tunnel syndrome indicating that the entrapment of the median nerve is followed by a loss of the autonomic function in these patients

Key words: Carpal tunnel syndrome, hyperthermic pattern, hypothermic pattern, distal latecy, cold stress test

Das Wärmebild von Patienten mit Karpaltunnelsyndrom mit einer distalen Latenz länger als 6,0 msek

Ziel der Studie war es zu klären, wieviele Karpaltunnel-Patienten mit einer Latenz von mehr als 6 msec ein hyperthermes Verteilungsmuster in der Thermographie zeigen. Das thermische Muster wurde durch Bestimmung der Differenz aus der mittleren Temperatur im medianus-innervierten Gebiet minus der mittleren Temperatur des ulnaris-innervierten Gebietes bestimmt. Ein Unterschied von zumindest 0,5 Grad wurde als hyperthermes Muster bezeichnet. Fand sich das ulnaris-innervierte Gebiet um zumindest 0,5 Grad wärmer wurde ein hypothermes Muster beschrieben. Bei 26 Personen wurden die Thermogramme von 52 Händen vor und nach einem moderaten Kältestresstest (KST) durch 20 Minuten im Abstand von 5 Minuten erhoben. Bei allen Personen wurde beidseits die Nervenleitgeschwindigkeit des N. medianus

N.medianus bestimmt. Die distale Latenz war bei 15 Händen länger als 6 msec (ausgeprägtes Karpaltunnelsyndrom =aK), an 17 Händen zwischen 4,1 und 5,8 msec (mäßiges Karpaltunnelsyndrom= mK), und im Normalbereich bei den verbleibenden 20 Händen.

Vor dem KST, fand sich an 5 aK-Händen ein hyperthermes und 3 Hände ein hypothermes Muster. 7 Hände mit mK boten ein warmes Medianusgebiet und 2 Hände dieser Gruppe zeigeten ein warmes Ulnarisgebiet. 4 mal wurde von den 20 gesunden Händen ein hyperthermes und 3 mal ein hypothermes Muster gefunden.

10 Minuten nach dem KST boten 5 Hände mit aK, 5 Hände mit mK and 4 gesunde Hände ein hyperthermes Muster. Ein hypothermes Medianusgebiet fand sich an 2 aK-Händen, 5 mK-Händen und 4 gesunden Händen. Zu diesem Zeitpunkt hatten 17 gesunde Hände, 12 mK-Hände und 9 aK-Hände die Ausgangstemperaturen wieder erreicht.. 20 Minuten nach dem KST, blieb die Temperatur des Medianusgebietes bei 5 gesunden, 3 aK- und 2 mK-Händen unterhalb der Ausgangstemperatur.

Als Schlußfolgerung zeigt sich eine geringer Erhöhung der Häufigkeit eines hyperthermen Musters bei Patienten mit ausgeprägtem Karpaltunnelsyndrom. Dies ist ein Hinweis darauf, daß die Einklemmung des Mittelhandnerven von einem Verlust der autonomen Funktion bei diesen Patienten begleitet ist.

Schlüsselwörter: Karpaltunnelsyndrom, hyperthermes Muster, hypothermes Muster, distale Latenz, Kältestresstest

Introduction

Diagnosis of carpal tunnel syndrome (CTS) by thermography is still under debate. Several authors (1,2,3,4,5) have claimed the possibility to diagnose the entrapement of the median nerve at the wrist by thermal imaging. Unfortunately most of these paper have some methodologic flaws, but other publications (6, 7,8) with better design were not able to confirm the value of thermography for the diagnosis of CTS. Recent systematic reviews (9, 10) of that topic have concluded, that thermal imaging cannot be recommended for the diagnosis of peripheral nerve entrapment syndromes. Lang has pointed out that thermography is not a diagnostic test but a valuable tool for assessment of the functional state of the autonomous nerve system (9). Uematsu (11) described different patterns in partial or total nerve injury. High sympathetic activity results from incomplete nerve destruction visible by vasoconstriction and low skin temperature in the affected area. Dissection of the nerve is followed by the loss of sympathetic activity with the consequence of vasodilation and increased skin temperature.

Hobbins (12) combined the thermal pattern with the time course of nerve injuries. He suggested the occurence of a hypothermic dermatome in the early phase of nerve entrapment and hyperthermic dermatomes in the late phase of nerve compression. Unfortunately data about classification of CTS with respect to the actual thermal pattern are not available.

A study was performed to answer the question how many patients with a distal latency of the median nerve greater than 6.0 msec present with a hyperthermic pattern ?

Methods

All subjects in the study were acclimatised for 15 minutes with bare arms in a room temperature of 24° C. Thermal images were performed of the dorsal hands prior to a cold stress test (CST, 3) and immedeately, 5, 10 minutes after. 15 minutes after the CST images were taken from a total of 42 hands and at 20 minutes after CST thermograms were available from 30 hands. Either an Agema 870 and NEC san-ei thermotracer were used to collect data..

Regions of interest were defined on each thermogram: the index finger for the median nerve and the little finger for the ulnar nerve. Additionally the areas of the sensory distribution on the palm projected to the dorsum of the hand were defined for each nerve

A high correlation was found between the temperature of the index finger and the sensory area of the median nerve ($r = 0.95$) and the ulnar area and little finger ($r = 0.95$) respectively (15).

A hypothermic pattern was diagnosed, if the mean temperature of the index was at least 0.5 degrees higher than the mean temperature of the little finger. The mean temperature of the

index at least 0.5 degrees lower than the mean temperature of the little finger was defined as a hypothermic pattern. The frequency of hyperthermic and hypothermic patterns was assessed before, 5, 10, 15 and 20 minutes after the cold stress test

Temperature recovery was defined as the actual temperature difference to baseline readings less than 0.5 degrees (13). Thermal recovery was assessed for the index finger 10, 15 and 20 minutes after the cold stress test.

In all patients nerve conduction measurements of both median nerves were performed. Patients presenting with a distal latency higher than 6.0 msec were diagnosed as severe carpal tunnel syndrome (sC). Hands with a distal latency between 4,1 and 6,0 msec were labelled as moderate carpal tunnel syndrome (mC).

Descriptive statistics were performed. The frequency of patterns was analyzed by the chi-square test using the programme SPSS -PC 4.0. For comparison of temperature values and distal latency between groups, the Mann-Whitney test was used.

Results

A total of 52 hands of 26 subjects (8 men and 18 women, age (mean ± standard deviation): 58.4 ± 18.4) were investigated. Nerve conduction testing revealed 15 hands with severe CTS (distal latency (mean ± standard deviation) 8.5 ± 2.5), 17 hands with moderate CTS (distal latency (mean ± standard deviation) 4.9 ± 0.5) and 20 healthy hands (distal latency (mean ± standard deviation) 3.6 ± 0.3). The distal latency was significantly different in all groups (p-values between 0.0013 und 0,0028). Patients with either severe or moderate carpal tunnel syndrome were significantly older than subjects without nerve entrapment.

Table 1 shows the absolute temperature values in the three groups of hands. A significant difference was found in the comparison of hands with moderate CTS and healthy hands for temperature values of the little finger prior to the CST (2-tailed p=0.03). All other temperature readings were just belowsignificance at this measurment point (2-tailed p-values between 0.06 and 0.16).

Table 2 details the occurence of thermal patterns at all measurment intervals. No significant difference of pattern distribution was revealed by chi-square testing (p-values between 0.92 (at the comparison of sC and healthy hands 10 minutes after CST) and 0.25 (at the comparison of mC and sC 5 minutes after CST).

Table 1 Temperature values

Severe CTS (mean ± standard deviation)

time	number	median nerve area °C	ulnar nerve area °C	index finger °C	little finger °C
before	15	32.5 ± 2.1	32.2 ± 2.1	32.2 ± 3.1	32,1 ± 2.6
5 min after	15	31.3 ± 2,2	31.0 ± 2.2	30.8 ± 3.1	30.6 ± 2.9
10 min after	15	32.3 ± 2.5	32.2 ± 2.5	32.3 ± 3.3	32.4 ± 2.8
15 min after	13	33.0 ± 2.3	32.9 ± 1.8	32.8 ± 3.0	32.9 ± 2.1
20 min after	7	32.1 ± 2.1	32.1 ± 1.5	32.5 ± 3.2	32.6 ± 1.9

moderate CTS

time	number	median nerve area °C	ulnar nerve area °C	index finger °C	little finger °C
before	17	31.8 ± 2.1	31.4 ± 2.1	31.6 ± 2.6	31.3 ± 2.5
5 min after	17	30.6 ± 2.0	30.2 ± 2.1	29.9 ± 2.8	29.9 ± 3.0
10 min after	17	31.8 ± 2.4	31.6 ± 2.6	31.6 ± 3.3	31.5 ± 3.1
15 min after	14	33.0 ± 2.3	31.5 ± 2.5	31.6 ± 3.0	31.5 ± 2.9
20 min after	8	31.7 ± 2.1	31.1 ± 2.3	31.5 ± 3.1	31.0 ± 3.2

healthy hands

time	number	median nerve area °C	ulnar nerve area °C	index finger °C	little finger °C
before	20	32.7 ± 2.1	32.7 ± 1.6	32.9 ± 1.8	33.1 ± 1.4
5 min after	20	31.9 ± 1.7	31.6 ± 1.9	32,.3 ± 2.3	32.3 ± 2.2
10 min after	20	33.0 ± 1.3	33.0 ± 1.2	33.4 ± 1.9	33.4 ± 1.6
15 min after	15	33:2 ± 1.4	33.1 ± 1.3	33.5 ± 2.1	33.2 ± 1.8
20 min after	15	33.1 ± 1.5	32.9 ± 1.4	33.0 ± 2.1	32,8 ± 1.9

10 minutes after CST 9 (60%) hands with sC, 12 (70,6%) with mC and 17 (85%) healthy hands presented complete temperature recovery. 20 minutes after CST 3 sC, 2 mC and 5 healthy hands still showed temperature readings below the values prior to the CST indicating Raynaud´s phenomenon of the index finger.

Discussion

Hands with severe CTS showed the lowest rate for thermal recovery at 10 minutes after cold stress test when 85 % of healthy hands have reached baseline temperature readings. A total of 5 hands (3sC, 2mC) presented with a pathological temperature gradient of the index 20 minutes after applying a mild cold stress test indicating cold-induced vasoconstriction. Raynaud´s phenomenon of single fingers was described in patients suffering from carpal tunnel syndrome (13,14) or from thoracic outlet syndrome (13,15) and its frequency might be underestimated in nerve entrapement syndromes. An association between reflex sympathetic dystrophy and generalized abnormal response to cold challenge was discussed (16,17). But the disturbence of skin temperature as the only symptom of our 5 patients does not fulfill the diagnostic criteria of chronic regional pain syndrome (CRPS) type 2 (18).

A slight increase of the frequency of hyperthermic patterns was found in hands with severe CTS during rewarming. This may be the indication for a loss of autonomic function in severe entrapment of the median nerve. Hyperthermia is a well accepteld sign for the loss of sympathetic function. Monitoring of sympathetic blocks (18, 19) or surgery (20) by thermometry was frequently recommended.

Unfortunately the natural course of carpal tunnel syndrome is only poorely understood. It seems that the delay of the distal latency is slowly progressive over time (21). Patients with changes of the conduction velocity of sensory nerve fibers only, rarely go to affect motor fibers (21). As sensory and motor fibers are thickly-myelinated nerves and more vulnarable to pressure than thin autonomic nerve fibers (9), disturbances of the autonomic function will not occur regularly during the natural course of carpal tunnel syndrome. Knowledge of the loss of autonomic regulation in the area innervated by the median nerve might contribute to the assessment of a possible benefit from decompressive surgery for CTS-patients.

An earlier study (22) found a specificity of 83% for clinical symptoms using the temperature difference between the index and the little finger at a cutoff point of 0.65 degrees. The occurrence of pathological temperature

Table 2 Thermal patterns

severe CTS			
time	hyperthermic	isothermic	hypothermic
before	5	7	3
5 min after	4	10	1
10 min after	5	8	2
15 min after	7	5	1
20 min after	7	2	1
moderate CTS			
time	hyperthermic	isothermic	hypothermic
before	7	8	2
5 min after	3	9	5
10 min after	5	7	5
15 min after	4	6	4
20 min after	4	4	1
healthy hands			
time	hyperthermic	isothermic	hypothermic
before	4	13	3
5 min after	5	11	4
10 min after	4	12	4
15 min after	5	9	1
20 min after	6	8	1

differences in asymptomatic hands, found in the earlier and in this study (7 of 20 healthy hands presented with a pathological pattern), may explain the low sensitivity of thermography for the diagnosis of carpal tunnel syndrome.

References

(1) Gateless D, Gilroy J, Nefey P. Thermographic evaluation of carpal tunnel syndrome during pregnancy. Thermology 1988; 3(1): 21-5.

(2) Herrick RT, Herrick SK: Thermography in the detection of carpal tunnel syndrome and other compressive neuropathies. J Hand Surg 1987; 12A: 943-9,

(3) Pascoe DD.,.Purohit RC, Shanley LA., Herrick RT. Pre- and post-operative thermographic evaluation of carpal tunnel syndrome. In: Ammer K, Ring EFJ, editors. The thermal image in medicine and biology. Wien: Uhlen Verlag; 1995. p. 188-90

(4) Pavot AP., Ignacio D, Tchou S. Thermography in peripheral nerve injury and its relationship to electroneuromyography. In: Mabuchi K., Mizushina S., Harrison B, editors. Advanced techniques and clinical applications in biomedical thermology. Chur: Harwood academic publishers, 1994. p: 255-64.

(5) Tchou S, Costich JF. Thermographic Study of Acute Unilateral Carpal Tunnel Syndromes. Thermology 1991; 3(4): 249-52.

(6) Lang E, Spitzer A, Pfannmüller D, Claus D, Handwerker HO, Neundörfer B. Function of thick and thin nerve fibers in carpal tunnel syndrome before and after surgical treatment. Muscle Nerve 1995: 18: 207-15.

(7) Meyers S, Cros D, Sherry B, Vermeire P: Liquid crystal thermography: Quantitative studies of abnormalities in carpal tunnel syndrome. Neurology 1989; 39: 1465- 9.

(8) So YT, Olney RK, Aminoff MJ. Evaluation of thermography in the diagnosis of selected entrapment neuropathies. Neurology 1989; 39: 1-5.

(9) Lang E: Stellenwert der Thermographie in der Diagnostik peripherer Nervenkompressions-Syndrome. Thermologie Österreich 1996; 6: 85-92.

(10) Kozakiewicz RT; Bowyer BL: Quantitative testing and thermography in carpal tunnel syndrome. Physical Medicine and Rehabilitation Clinics of North America 1997; 8(3) :503-11.

(11) Uematsu S: Thermographic imaging of cutaneous sensory segment in patients with peripheral nerve injury. J Neurosurg 1985: 62: 716-20.

(12) Hobbins WB. Autonomic Vasomotor Skin Changes in Pain States: Significant or Insignificant ? Thermologie Österreich 1995; 5(1): 5-14.

(13) Ammer K. Thermographic Diagnosis of Raynaud's Phenomenon. Skin Research and Technology 1996; 2: 182-185.

(14) Neundörfer B, B.Dietrich, B.Braun: Raynaud-Phänomen beim Carpaltunnelsyndrom. Wien Klin Wochenschr 1977; 89: 131-3.

(15) Schartelmüller T, Ammer K, Hold M. Zervikaler Diskusprolaps, Thoracic Outlet Syndrome oder periphere arterielle Verschlußkrankheit-ein Fallbericht. European Journal of Thermology 1997; 7(3) 146-50.

(16) Cooke ED, Beacham JA, Almond NE, Ward C, Smith RE. Reflex sympathetic dystrophy (algoneurodystrophy): temperature studies in the upper limb. Br.J.Rheumatol 1989; 28(5):399-403.

(17) Herrick A, Jayson M, Marsh D.,el Hadidy L. Abnormal thermoregulatory responses in patients with reflex sympathetic dystrophy syndrome. J. Rheumatol 1994; 21(7): 1319-24.

(18) Hord AH, Fleming LL, Rogers HG, Stepelms BO, Rooks MD. Intravenous regional bretylium and lidocaine for treatment of reflex sympathetic dystrophy: a randomized, double-blind study. Anaesth Analg 1992; 74(6): 18-21.

(18) Wilson PR., Low PA., Bedder MD.,Covington EC.,Rauck RL. Diagnostic Algorithm for Complex Regional Pain Syndromes. In:Jänig W, M.Stanton-Hicks (eds): Reflex Sympathetic Dystrophy: A Reappraisal. Seattle: IASP Press, 1996; p. 93-105.

(19) Irrzuzta JE, Sethna NF, Berde CB. Laser Doppler measurements of skin blood flow before, during and after lumbar sympathetic blockade in children and young adults with reflex sympathetic dystrophy syndrome. J Clin Monit 8:1; 1992; 116-29.

(20) Cho Y-E, Kim Y-S. Pre and postoperative digital infrared thermographic imaging (DITI) of thoracic sympathectomy for palmar hyperhidrosis. In: Ammer K, Ring EFJ, editors.: The thermal image in medicine and biology. Wien: Uhlen Verlag; 1995. p. 191-6.

(21) Schartelmüller T, Ammer K, Melnizky P. Natürliche und postoperative Entwicklung elektroneurographischer Untersuchungsergebnisse des N. medianus von Patienten mit Carpaltunnelsyndrom (CTS). Österr Z Phys Med 1997; 7: 183-84.

(22)Ammer K: Thermographische Diagnose von peripheren Nervenkompressionssyndromen. ThermoMed 1991; 7: 15-21.

Address of the Author

OA.Dr.Kurt Ammer

Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik

Heinrich Collinstr. 30, A-1140 Wien, Österreich

(Manuscript received on 28.12.1998, accepted on 8.1.1999)

Infrarotthermographie zur Evaluierung des Erfolges physikalischer Therapie bei Patienten mit klinischem Verdacht auf Thoracic Outlet Syndrome

T.Schartelmüller+*, P.Melnizky+*, B.Engelbert°

+Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik (Vorstand: Prim.Dr. O.Rathkolb),Wien

* Institut für Physikalische Medizin am Hanuschkrankenhaus, (Vorstand: Prim.Dr. O.Rathkolb),Wien,

°Gesundheitszentrum Physiko der Wiener Gebietskrankenkasse (Vorstand: Prim.Dr. O.Rathkolb), Wien

Kurzfassung

Der diagnostische Wert der Infrarotthermographie zur Diagnostik der milden Form des durch andere bildgebende oder neurophysiologische Verfahren nicht sicher faßbaren Thoracic Outlet Syndrome (TOS) wurde bereits nachgewiesen. Vor und nach drei verschiedenen Streßtests werden Thermogramme beider Hände angefertigt und die Differenz der mittleren Temperatur des Zeige- und Kleinfingers, stellvertretend für die Versorgungsgebiete des N.medianus und N.ulnaris, berechnet. Eine Temperaturdifferenz >0,5° wird als pathologisch angesehen. Diese Tests wurden in einer Gruppe von 10 Patienten vor und nach physikalischer Therapie durchgeführt. Der signifikante Unterschied der thermographischen Ergebnisse vor und nach Therapie korreliert gut mit der Besserung der klinischen Symptome nahezu aller Patienten. Daher scheint die Infrarotthermographie auch ein geeignetes Verfahren für den Nachweis des Therapieerfolges bei Patienten mit TOS zu sein.

Schlüsselwörter: Thoracic Outlet Syndrome, physikalische Therapie, Thermographie

Infra red thermography for the assessment of physical therapy for patients with suspected thoracic outlet syndrome

The diagnostic value of Infrared Thermography for the diagnosis of the mild form of Thoracic Outlet Syndrome (TOS) has already been proven. Before and during three different stress tests, thermograms of both hands are taken. The mean temperatures of the second and fifth finger on the same hand, representing the areas supplied by the median and ulnar nerve, are compared. A cooling greater 0.5° of one of these fingers compared to the other proves the anamnestical paresthesias and sensation of cooling and reinforces the diagnosis of TOS. In a group of 10 patients these tests were performed before and after physical therapy. A significant difference of thermographic findings after therapy is correlating well with the clinical improvement in almost all patients. Therefore the usefulness of IR-thermography as a method of monitoring the success of treatment of patients suffering from TOS seems to be proven.

Key words: Thoracic Outlet Syndrome, Physical Therapy, Thermography

Einleitung

Unter dem Begriff “Thoracic Outlet Syndrome” (TOS) werden eine ganze Reihe verschiedener Kompressionsphänomene von Nerven und Gefäßen der oberen Extremität, genauer gesagt im Bereich der oberen Thoraxapertur, zusammengefaßt. Grundsätzlich wichtig scheint uns die Differenzierung zwischen der klassischen Form des TOS (1) mit schweren neurologischen und vaskulären Ausfällen, und der sozusagen “milden” Form, bei der diese Ausfälle

nicht so schwerwiegend oder nur zeitweise auftreten. Während die Ursache der Er- krankung in der sehr seltenen ersten Gruppe oft eine anatomische Variante, wie zum Beispiel eine zusätzliche Halsrippe oder ein fibröses Band zwischen einem Querfortsatz eines Halswirbels und dem Schlüsselbein ist, stehen die möglichen Ursachen für die milde Form meist in Zusammenhang mit der Haltung im Bereich der unteren Halswirbelsäule und des Schultergürtels. Die Patienten dieser zweiten Gruppe klagen meist über zeitweise auftretende Parästhesien und Kältegefühl in den Fingern, häufiger im Versorgungsgebiet des N.ulnaris als in dem des N.medianus. Die primäre Verdachtsdiagnose lautet daher meist Sulcus ulnaris Syndrom oder Karpaltunnelsyndrom.

Die apparative Diagnostik der milden Form des TOS gestaltet sich äußerst schwierig (2), da die oben beschriebenen Symptome, im Gegensatz zur schweren Form, selten durch eine faßbare pathologische Veränderung der Morphologie der betroffenen Strukturen begründet sind. Elektromyographie, Nativröntgen, CT (3) und MRI (4) sowie in den Fällen mit vaskulärer Affektion (5) auch Gefäßdoppler und Angiographie, die bei der schweren Form durchaus diagnostisch erfolgreich sein können, sind zum Nachweis der milden Form nicht geeignet. Selbst die vom Ansatz her funktionellen Untersuchungsmethoden der Elektrodiagnostik (6) wie Messung der Nervenleitgeschwindigkeit (7, 8) und Evozierte Potentiale (8, 9) bringen keine verläßlichen Aussagen. Somit bleibt außer den klinischen Streßtests wie dem Costoclavikularmaneuver, dem Hyperabduktionstest und dem Adson-Maneuver als apparativ-diagnostische Mög- lichkeit nur die Infrarotthermographie (10, 11), deren Sensitivität und Spe- zifität bei dem beschriebenen Patientengut bereits nachgewiesen wurde. Auch die Verläßlichkeit der Auswertung der thermographischen Ergebnisse wurde bereits untersucht (12). Ziel dieser Arbeit ist es, die Wertigkeit der IR-Thermo- graphie als Instrument zur Kontrolle des Therapieerfolges von physikalischer Therapie bei Patienten mit Symptomen der milden Form des TOS zu überprüfen.

Methode

Alle Patienten wurden bei der klinischen Untersuchung durch Durchführung von Hyperabduktionstest, Costoclavikularmaneuver und Adson- Maneuver auf Symptome im Sinne eines TOS unterzogen. Zumindest ein positiver klinischer Test war Voraussetzung für die Durchführung der folgenden thermographischen Untersuchung. Nach 15-minütiger Adaptation an die Raumtemperatur von 24°C wurden von jeder Hand der Patienten vier Thermogramme angefertigt. Das erste vor den Tests und die weiteren jeweils während bzw. nach einem der Provokationstests, und zwar während des Hyperabduktionstests (Oberarm im Schultergelenk maximal abduziert, Ellbogen 90° gebeugt, Handfläche nach ventral weisend unter maximaler Inspiration und maximaler Kopfdrehung zur betroffenen Seite), nach der Faustschlußprobe (30 mal schließen und öffnen der Faust bei wie oben abduziertem Arm, mit der Intention, einen vaskulären Streß auszuüben), und schließlich während des modifizierten Adson's Tests (herabhängender Arm, maximale Inspiration und Kopfwendung zur Gegenseite, Abbildung 1). Dann wurde durch Erstellung einer "region of interest" die mittlere Temperatur des zweiten und fünften Fingers als Hautversorgungsgebiete des N.media- nus bzw. N.ulnaris gemessen, und eine Differenz >0,5°C als pathologisch im Sinne eines TOS gewertet.

An einem Kollektiv von 10 Patienten, alle weiblich, mit einem Alter von 43-59 Jahren (Median: 52) wurden diese thermographischen Tests vor und nach physikalischer Therapie (der zeitliche Abstand zwischen erster und zweiter Thermographie betrug 3 bis 11 Wochen mit einem Median von 5) durchgeführt. Von den 10 Patientinnen klagten vor der Therapie 7 über beidseitige Beschwerden, 2 nur rechts und eine nur links.

Die Therapie bestand in allen Fällen aus Einzelheilgymnastik, deren Ziel einerseits die Erweiterung des costoclaviculären Raumes bzw. der Scalenuslücke, und andererseits die Kräftigung der medialen Schulterblattfixatoren und somit eine Gesamtverbesserung der Haltung des Schultergürtels war. Je nach klinischer Symptomatik erhielten einige Patienten zusätzlich Elektrotherapie in Form von Impulsgalvanisationen 50/70 mit den Elektroden im Nacken und an der Hand oder Wärmetherapie (Moorpackungen oder Munari) und Teilmassagen im Bereich der HWS und des Schultergürtels.

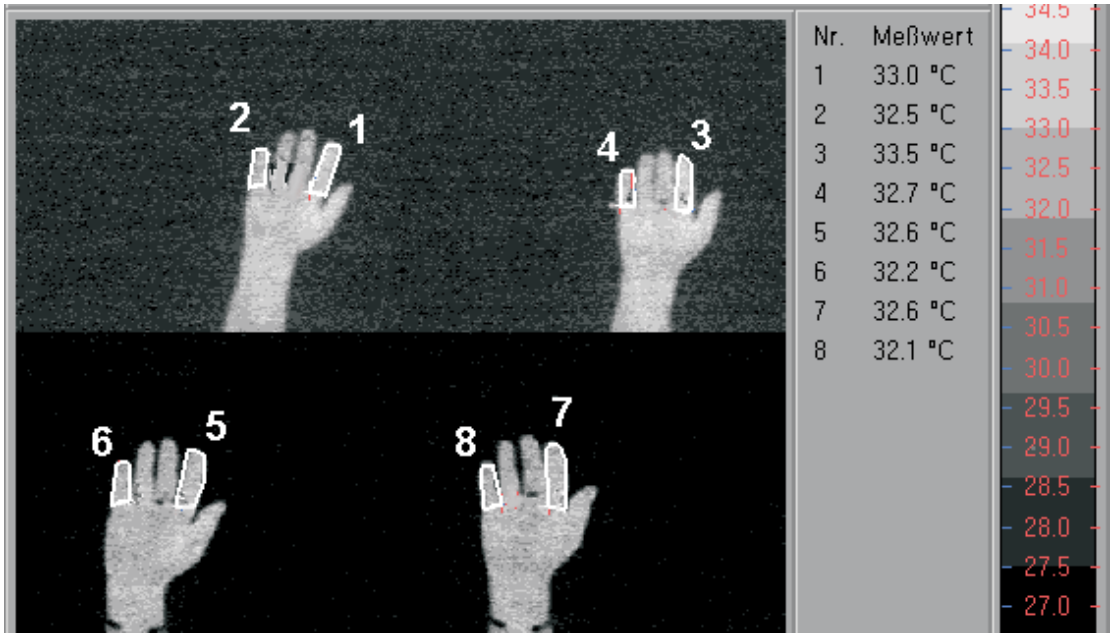


Abbildung 1:
Thermogramme der rechten Hand einer Patientin vor (obere Zeile) und nach (untere Zeile) Therapie, links vor den Streßtests und rechts nach der Faustschlußprobe. Man beachte die mittleren Temperaturen

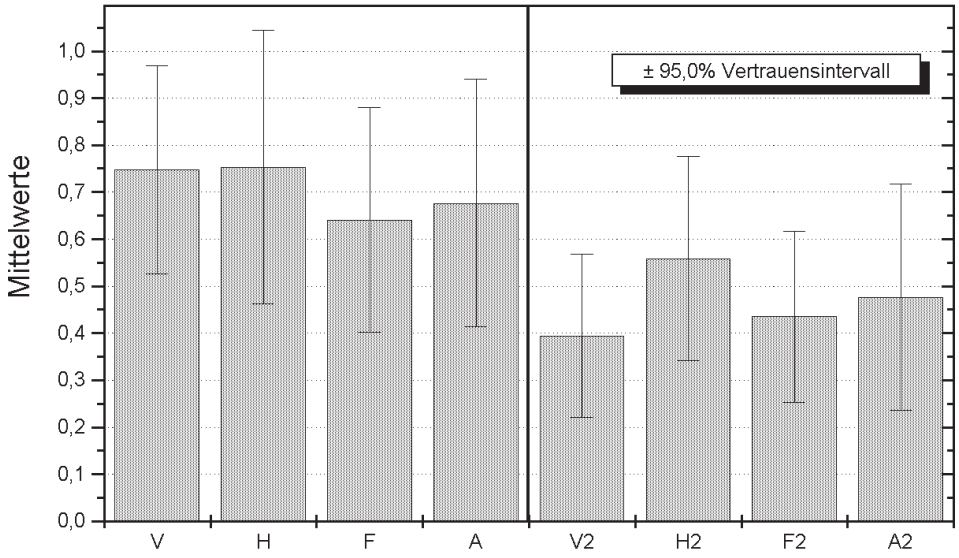


Abbildung 2:
Mittelwerte der Temperaturdifferenzen zwischen Zeige- und Kleinfinger der symptomatischen Hände vor und nach Therapie, ± 95% Vertrauensintervall.

Ergebnisse

Die oben beschriebene Therapie führte bei 7 der 10 Patientinnen zu einer deutlichen klinischen Besserung, eine Patientin hatte zuvor beidseits und nach der Therapie nur mehr auf einer Seite Beschwerden, und bei zwei Patientinnen kam es sogar zu einem völligen Verschwinden ihrer Beschwerden.

Neben diesem erfreulichen klinischen Ergebnis zeigt die deskriptive Statistik eine im Schnitt deutliche Verminderung der Temperaturdifferenzen nach der Therapie (Abbildung 2). Die Abkürzungen bedeuten in allen Abbildungen: V: vor den Tests, H: während Hyperabduktionstest, F: nach Faustschlußprobe, A: während des Adson- Maneuvers, und V2, H2, F2, A2: dieselben bei der zweiten thermogra- phischen Untersuchung, also nach der Therapie.

Noch anschaulicher wird die Verminderung der Temperaturdifferenzen zwischen Zeige- und Kleinfinger durch die Darstellung der Streudiagramme (Abbildung 3), wo die Differenzen der einzelnen Tests am selben Individuum vor und nach Therapie gegenüber ge- stellt werden. Der Punkt oberhalb der eingezeichneten Diagonale bedeutet eine größere Differenz nach Therapie ("Verschlechterung"), auf der Diagonale gleiche Differenz und un- terhalb der Diagonale geringere Differenz nach Therapie ("Besserung"). Für die Darstellung dieser Streudiagramme wurden nur die symptomatischen Hände der Patientinnen ausgewertet, das schraffierte Rechteck in der linken unteren Ecke soll den Normbereich (Temperaturdifferenz <0,5°) veranschaulichen.

Die Durchführung des Wilcoxon Tests für Paardifferenzen brachte für das Thermogramm vor den Tests ein hochsignifikantes Ergebnis (p=0,0005), keine Signifikanz beim Hyperabduktionstest (p=0,07), und signifikante Unterschiede für Faustschlußprobe (p=0,01) und Adson- Maneuver (p=0,03).

Diskussion

Sehr anschaulich wird die Korrelation zwischen Klinik (alle Patienten berichteten über eine Besserung) und thermographischer Untersuchung am Beispiel des Thermogramms vor den Tests dargestellt. Wenn auch nur wenige Ergebnisse nach der Therapie innerhalb des Normbereichs liegen, so kommt es doch zu einer deutlichen Besserung, also Verminderung der Temperaturdifferenz zwischen Zeige- und Kleinfinger. Jedenfalls war diese Entwicklung deutlicher als die der zugegebenermaßen schwieriger, weil subjektiv, zu beurteilenden klinischen Tests, die nur bei etwas weniger als 50% der Patienten nach der Therapie negativ geworden waren.

Die Effektivität der Infrarotthermographie als Instrument zum Therapiemonitoring wurde unter anderem bereits beim Beschwerdebild der Epicondylopathie (13) nachgewiesen. Ther-

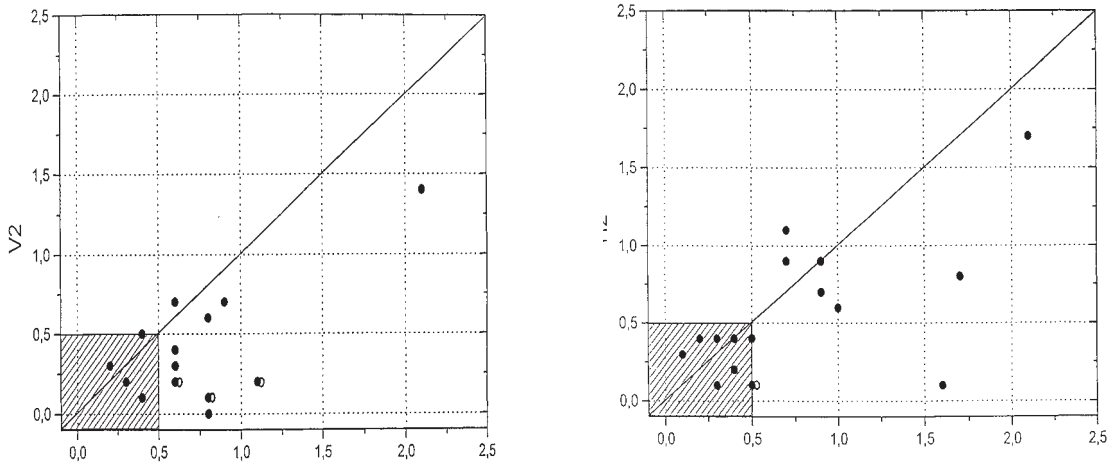


Abbildung 3
Vergleich der Temperaturdifferenzen vor und nach Therapie am einzelnen Individuum, Streudiagramme.

mographische Untersuchungen wurden allerdings nicht nur zur Überprüfung der Wirksamkeit physikalischer Behandlungen (14), sondern auch in der klinischen Pharmakologie (15) erfolgreich angewandt.

Die Ergebnisse dieser Studie bestätigen einerseits die Effizienz einer heilgymnastischen Therapie bei Patienten mit klinischen Beschwerden im Sinne eines TOS, und andererseits wird die Wertigkeit der Infrarotthermographie bei diesem Patientengut nicht nur als primäres Diagnostikum, sonder auch als valides Mittel zur Überprüfung des Therapieerfolges aufgezeigt.

Literatur

(1)Adson AW: Surgical Treatment for Symptoms Produced by Cervical Ribs and the Scalenus Anticus Muscle. Gynecol Obstet 85: 687, 1947 (reprint) Clin Orthop Rel Res 1986; 207: 3-12

(2) Cuetter AC, Bartoszek DM. The Thoracic Outlet Syndrome: Controversies, Overdiagnosis, Overtreatment, and Recommendations for Management. Muscle Nerve 1989; 12: 410-9

(3) Bilbey JH, Müller NL, Connell DC, Luoma AA, Nelems B. Thoracic Outlet Syndrome: Evaluation with CT. Radiology 1989; 171: 381-4

(4) Panegyres PK, Moore N, Gibson R, Rush worth G, Donaghy M. Thoracic outlet syndromes and magnetic resonance imaging. Brain 1993; 116(4): 823-41.

(5) Grant DS, Shaw PJ, Adiseshia M. Vascular Compression in Thoracic Outlet Syndrome- a Potentially missed diagnosis. R. Soc. Med. 1988; 81: 476-8

(6.) Schnyder H., Rösler KM, Hess CW. Die diagnostische Bedeutung von elektrophysiologischen Zusatzuntersuchungen bei Verdacht auf neurogenes Schultergürtelsyndrom("thoracic outlet syndrome"). Schweiz Med Wochenschr 1994; 124: 349-56

(7) Huffman JD: Electrodiagnostic Techniques for and Conservative Treatment of Thoracic Outlet Syndrome. Clin Orthop Rel Res 1986; 207: 21-3

(8) Livingstone EF, .DeLisa JA, .HalarEM. Electrodiagnostic Values Trough the Thoracic Outlet Using C8 Root Needle Studies, F-Waves and Cervical Somatosensory Evoked Potentials. Phys Med Rehab 1984; 65: 726-30

(9.) Chodoroff G, Lee DW, Honet JC. Dynamic approach in the Diagnosis of Thoracic Outlet Syndrome Using Somatosensory Evoked Responses. Phys Med Rehabil 1985; 66: 3-6

(10) Lang E: Stellenwert der Thermographie in der Diagnostik peripherer Nervenkompressionssyndrome. Thermol Österr 1996; 6(2): 85-92.

(11) Schartelmüller T, AmmerK. IR-Thermography for the diagnosis of Thoracic Outlet Syndrome. Thermol Österr 1996; 6(4): 130-4.

(12) Melnizky P, Schartelmüller T. Ammer K. Prüfung der intra- und interindividuellen Verläßlichkeit der Auswertung von Infrarotthermogrammen. Eur J Thermol 1997; 7(4): 224-7

(13.) Ammer K, Solar S, Kern E. Birtalan L, Engelbert B. Thermographische und algometrische Kontrolle der physikalischen Therapie bei Patienten mit Epicondylopathia humeri radialis. ThermoMed 1995; 11: 55-67

(14)Rusch D: Temperaturmessung zur Dokumentation der Wirksamkeit der physikalischen Medizin. Thermol Österr1993; 3(1): 29-31

(15) Ring EFJ, Engel JM, Page Thomas DP. Thermologic Methods in Clinical Pharmacology.J Clin Pharm Ther and Toxicol: 1984; 20-4.

Adresse des Autors:

Dr.Thomas Schartelmüller

Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik im Hanuschkrankenhaus,

Heinrich Collinstr. 30, A-1140 Wien

(Manuskript erhalten am 30.8.1998, angenommen am 30.9.1998)

Thermology on the Internet

K.Ammer

General Secretary of the European Association of Thermology; Vienna, Austria

Introduction

Worldwide information is growing every minute and the world wide web is one of the most accepted mediums nowadays to generate and distribute informations. Although the quality of the information found on the web is inhomogeneous and only a part of the contents meet the requirements for science, the internet contributes greatly to the evaluation of products, techniques and procedures.

The publication of scientific papers has already been modified by this new medium and most of the important medical publishers produce printed and online versions of their journals in parallel. Abstracts and sometimes full text versions of papers from the major medical journals can be accessed on the web.without charge.

The advertising business is highly affected by the rapid growth of the internet. Web design is one of the best paid areas in graphic design. Selling on the internet is also a growing business and nearly everyone is making an attempt to produce his personal web page.

It is therefore clear, that thermology is not excluded from this development. During regular searches for web sites with the key words „thermography“,„thermology“ or „infrared imaging“ the author has found some useful and some annoying sites. Both are reported here.

Web sites dealing with thermology can be generally classified into 4 groups: equipment, applications, users and publications.

Equipment

Nearly all manufacturers of infra red imagers have their own website, partially produced in cooperation with their main distributers. Table 1 lists the addresses of these sites. Most of them include some pages on application of thermography. In the medical field unproven conclusions and out of date indications for the use of this technique are sometimes promoted. I think that the representatives of the ther- mology societies should contact the authors of these web sites and try persuade the authors to modify the contents of the recommendations for medical use, if they are not in line with the actual status of science in thermology. Unless those inaccuracies can be removed, there could be problems for the correct understanding of the technique.

Most of the equipment is designed for industrial use only and and must be adapted for medical thermal imaging, because of the working temperature range or the lack of software for quantification. Ashwin, Bales Meditherm and Thermascan promote also the use of their equipment for medical imaging. But based on the given specifications, other products should meet this task. Focal plane arrays have become more common and some equipment is available for less than 20.000 $. Special applications such as non destructive material testing or use in wet marine environments are achieved by special designed equipment. Sensors, software, acquisation cards and systems for testing infrared equipment are also offered on the net. Contact thermometers used in „regulation thermography“ are promoted in Germany and the United States by one manufacturer.

The Electronic Technology Office of DARPA (Defence Advanced Research Projects Agency) has included Infrared Focal Plane Arrays and

Table 1 Internet sites for Thermology equipment

ADDITIONAL http//thermographie.com

Agemahttp:http://equitronics.com/agema.htm
http://flir.com/products/rd/570.htm

Amiris
http://www.cplath.com/products/amiris2100.htm

Ashwin (Teletherm)
http://www.home1.gte/infrared

Bales http://www.balesscientific/equipment/

Cincinnati Electronics
http://www.cinele.com/products/dmdl/

Compix http://www.compix.com

Eidam (regulation thermography)
http.//home.t-online.de/home/EidamMedTech/
http://www.thermography.net

Electrophysics
http://www.electrophysicscorp.com

ETO-Sensors
http://www.darpa.mil/eto/sensors/index.htm

Flirhttp://flir.com/products/
http://www.electricnet.com/cofolder/flirsys.htm

Inframetrics
http://www.inframetrics.com/index.htm

Infrared http.//www.infrared.com

ISI
http://www.isigroup.com/products/index.html

Jenoptik http.//www.jenoptik-los.de/
http.//www.infratec.de/ittgsyst.htm

Land http://www.landinst.com/infr/

Lumitron http://www.lumitron.com

Meditherm http://www.meditherm.com

Mikron http://www.mikroninst.com

NEC San-ei:
http://nbn.de/thermo.htm
http://www.ebs-thermography.com/data-d/index.htm

Nikon
http://www.klt.co,jp/Nikon/LAIRD
http://www.ebs-thermography.com/data-d/index.htm

Optimashttp://optoelectronic-world.com/vsd/vsdco/optimas.htm

Raytheon (früher Amber):
http://lot-oriel.com/de/thermogr.htm
http:// lot-oriel.com/uk/amber.htm
http://www.raytheon.com/rtis/

SE-IR http://www.seir.com

Spectrum
http://spectrum-instruments.com/iis.htm

Stressphonics
http://www.stressphonics.com

Thermal Wave http://thermalwave.com

Thermascan
http://www.thermascan.com

Vision Technologies
http://www.visiontechnologies.net/ir.html

Western Sensor
http://www.dmi.net/ir-sensor/index1.htm

Uncooled & Novel IR Detector Material in their research programme.

Applications

1. Industrial and technical

1.1. Non destructive testing

Non destructive testing by thermal imaging of material seems now to be the most intensively investigated task in technical and industrial use of thermography. Pulse locked thermo- graphy, where energy given for a very short time to the investigated material modifies the local thermal response, is a very promising technique for non destructive testing which is used in the maintenance of aircraft.

1.2. Buildings

Heat loss by leaks in the insulation of buildings and roofs may be detected by thermal imaging. Several conditions influence the thermo grams of buildings and this application for thermography is under serious discussion. Nevertheless many of the thermographic services still offer thermographic building surveys.

1.3. Electrics and Electronics

Changes of the electrical resistance of electric or electronic equipment will affect the surface temperature of such devices. Monitoring by thermography may detect heating of components, which may lead to electrical failures.

Differences in emissivity of the materials usedcan cause misinterpretation of the thermal images.

1.4. Infra red viewers

There is a wide field for the use of infra red viewers ranging from military use and border surveillance to fire fighting.

2. Medical

2.1.Medical thermography

Six sites include information on medical thermography, three additional deal with regulation thermography. Inframetrics and Flir, the new owner of Agema, do not even mention medical use of thermography.

Unfortunately, the quality of medical thermography sites is in most cases rather poor, the proposed indications out of date or now obsolete, the presented thermograms uncertain (for example one thermogram of a female breast has a temperature label ranging from 57.8 to 66.3 °C !).The need for quantification is not mentioned on any of these sites.

A service provider from Germany argues that thermal imagers need nitrogen cooling and because of the high costs for equipment, he offers support in medical application. What equipment he does uses and is the rest of his service actually as literal as this statement.

On the web pages in the german language a relationship between thermography and complimentary medicine is often made.

2.2. Regulations thermography

A site of a German thermographic service providers gives an example for regulation thermography of the female breast. An equipment manufacturer for this measurement procedure promotes his equipment in the US and in Germany. The numbers of users cited is definitely exaggerated.

3. Veterinary and other applications

Thermography as a diagnostic tool for disorders of horses is promoted on two web sites. As in the thermal images of humans quanti- tation is not mentioned.

Publications can be found about the use of thermography in botany performed in the university of Heidelberg.

A paper in German reports on the use of infrared sensors for the detection of sick or injured wild animals during gras cutting or reaping corn with large machinery.

4. Astronomy

Fascinating images from the universe can be obtained from several sites dealing with infra red astronomy. Most of them are totally or partly supported by the NASA. The infrared equipment and the research programme from the Physics & Astronomy department at UCLA, Arizona is described on their home page. Some abstracts of publications dealing with infrared astronomy and also research reports can be detected on the world wide web.

Institutions

National Physical Laboratory (NPL)

As the UK's national standards laboratory, NPL has a mission to satisfy the nation's current and future needs for physical measurement standards. Meeting this task, standards for infra red and temperature measurements can be found on this web site.

SPIE

The International Society of Optical Engineering runs a big site with a great deal of information of coming and past conferences, education, optical standards, membership, publications and industry news.The SPIE journals can also be found online.

Thermographic services

Many commercials offer thermographic services on the internet ranging from renting equipment to industrial and medical applications. Several firms offer training facilities and expertise in reviewing the results from thermal imaging. Training courses can be found either on the web sites of thermographic services or on manufacturer´s sites.

Thermology Societies

Austrian Society of Thermology

The home page of the Austrian Society of Thermology is under construction.

Australian Thermology Association

The Australian Thermology Association cooperates with Meditherm and other Health Organisations engaged in counselling women with health problems.

German Society of Thermology

The comittee of the German Socitey decided in the last business meeting to install a web site

for the society, which is currently under construction.

Japanese Society of Thermology

The home page anonnouced by Prof. Fujimasa in several publications under the adress

http://biomed.poli-sci.saitama-u-ac.jp/bmth/

is not accessable on the net.Hopefully this interesting site will be transfered to a new server in the near future.

International Thermographic Society

This group based on chiropractice claims to perform research and education in medical thermography. Looking into the published newsletter and some papers from one author does not support the impression of a good medical site.

QIRT

The Eurotherm Committee produced a web site showing an overview of their conferences on quantitative infrared thermography. This organization is slowly starting to include medical applications in their programmes after having realized that quantification of thermal images is an established procedure in medical thermo- graphy.

Universities

The most important university web site for medical thermography is to date the thermography page of the University of Glamorgan. (http://www.glam.ac.uk/pages/IR_ACHIVE / default.htm). This site provides the facility to an archive of all issues of the journals "Acta thermographica" and "Thermology" and also a reference database including thermographic citations from 1989 to 1998. This journal "Thermology international" will be also ac- cessable on this website with the table of contents and some selected abstracts of papers.

In addition this university offers a PH.D. Degree by publications based on thermology. More details can be found on the web page.

Conferences

The number of medical conferences on infrared imaging, thermology or thermography is surprisingly small. Only one meeting in Tampa on Infrared Thermal Imaging in Clinical Practice held in January could be identified. Announcements of other meetings from the American Academy of Thermology, the Asian-Pacific Conference or the THERMO- Congress in Budapest are not found. If one searchs in the conference calendars of SPIE, the National Societies for non destructive Testing or the NPL some additional meetings of interest can be found.

Manufactures and thermographic service providers offer long lists of training facilities for infra red imaging.

Personal Web Pages

The CVs of staff members is a regular feature of the web sites from universities. Therefore the CVs of a number of proponents of infrared thermography can ber accessed on the web including Prof. R. Clark, Prof.I. Fujimasa, Prof. B.Jones, Dr. H.Hooshang, Prof. RC. Purohit and Prof.F.Ring .

Publications

Journals

Acta thermographica, Thermology

Both journals can be accessed in full text with all illustrative images on the thermology page of Glamorgan.

Revue Generale de Thermique, Infrared Physics and Technology

Both journals are published by Elsevier, basic informations can be obtained from the Elsevier home page.

Thermology international

Table of contents and abstracts of selected papers will be available soon on the Glamorgan website.

DACH

The journal of the German Society for Non- destructive testing contains some useful papers on thermographic applications in this field. Links to the national and international societies for non destructive testings give access to some abstracts or full versions of conference papers.

SPIE Journals Online

SPIE Journals Online is produced and maintained for SPIE by the American Institute of Physics (AIP) as part of AIP's Online Journals Publishing Service. Issues are available online at http://ojps.aip.org. Tables of contents and abstracts may be viewed without subscription. Full text is accessible to subscribers only.

General publications

Most of the medical thermography sites contains some general publications on thermography, also lists of thermographic references. Sometimes papers from the IEEE meetings can still be obtained. Some publications by chiropractors can also be found on the web.

Other Internet publications

A full version of a thesis of a physicist studying the heat flow on the surface of the ocean by thermography is available.

Another paper reports the use of thermography to assess the eruption of an vulcano in Hawai.

Attractivec pages on infrared astronomy can be accessed.

Conclusion

A variety of thermologic information can be found on the world wide web. As the quality of publications in this medium is not regulated, the consequence is a mixture of commercial advertising, beliefs, promises and real science. Nevertheless the internet seems to be a useful means of promoting thermology and strict review mechanism of the publications on the web might help to avoid the possible harm for the credibility of infrared imaging, resulting from misuse of this technique.

Jahrestagung der Deutschen Gesellschaft für Thermologie in Celle vom 14.11.1998 Kurzfassungen

Chronisches Regionales Schmerz-Syndrom (CRPS)

K. Ammer

Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik (Leiter: Prim.Dr.O.Rathkolb), Wien

Unter dem Begriff Chronisches Regionale Schmerz-Syndrom (CRPS) werden jene Beschwerdebilder zusammengefasst, die früher als Sympathische Reflexdystrophie, Algodystrophie, M. Sudeck oder Kausalgie bezeichnet wurden. Ätiologisch kann man postraumatische (M.Sudeck), nervale, reflektorische und idiopathische Formen unterscheiden. Der Einschluß der Kausalgie in die Diagnose eines CRPS bedingt, dass die Erstbeschreibung des Krankheitsbildes dem Amerikaner Mitchell zugeschrieben wird. Für die posttraumatische Form ist der Hamburger Chirurg Sudeck als Erstbeschreiber zu nennen.

Sudeck hat in seiner Schilderung der Erkrankung eine Knochenentzündung postuliert, wohl aufgrund des Vorliegens klassischer Entzündungszeichen wie Schwellung, Rötung, Überwärmung, Schmerz und ausgeprägte Funktionsstörung. Die Hauttemperatur ist im Regelfall im Akutstadium erhöht und im chronischen dystrophen Endstadium erniedrigt.

Seit langem wird eine Erhöhung der Aktivität des sympathischen Nervensystems eine pathogenetische Rolle beim CRPS zugesprochen. Die Auswirkungen des Sympathikotonus auf die Zirkulation werden jedoch im Anfangstadium der Erkrankung durch die Wirkung von Schmerz- und Entzündungsmediatoren überspielt, sodass der Großteil der Patienten sich mit deutlich hyperthermen Gliedmassen präsentiert.

Diagnosekriterien für den M.Sudeck, die sogenannte Sympatische Reflexdystrophie und für die aktuelle Zuordnung zu einem CRPS Typ I oder Typ II werden referiert werden. Die Diagnosestützung mittels bildgebender Verfahren wie Nativröntgen, Skelettszintigraphie, Knochenszintigraphie und Magnetresonanz wird dargestellt werden. Die Bedeutung der der thermographischen Untersuchung wird dargestellt.

Infrarotthermographie zur Evaluierung des Erfolges physikalischer Therapie bei Patienten mit klinischem Verdacht auf Thoracic Outlet Syndrome

T.Schartelmüller+*, P.Melnizky+*, B.Engelbert°

+ Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik, (Leiter: Prim.Dr.O.Rathkolb),Wien,

* Institut für Physikalische Medizin am Hanuschkrankenhaus, Wien,(Vorstand:Prim.Dr. O.Rathkolb)

° Gesundheitszentrum Physiko der Wiener Gebietskrankenkasse, Wien, (Vorstand:Prim.Dr. O.Rathkolb)

Der diagnostische Wert der Infrarotthermographie zur Diagnostik der milden Form des durch andere bildgebende oder neurophysiologische Verfahren nicht sicher faßbaren Thoracic Outlet Syndrome (TOS) wurde bereits nachgewiesen. Vor und nach drei verschiedenen Streßtests werden Thermogramme beider Hände angefertigt und die Differenz der mittleren Temperatur des Zeige- und Kleinfingers, stellvertretend für die Versorgungsgebiete des N. meianus und N.ulnaris, berechnet. Eine Temperaturdifferenz >0,5° wird als pathologisch angesehen. Diese Tests wurden in einer Gruppe von 10 Patienten vor und nach physikalischer Therapie durchgeführt. Der signifikante Unterschied der thermographischen Ergebnisse vor und nach Therapie korreliert gut mit der Besserung der klinischen Symptome nahezu aller Patienten. Daher scheint die Infrarotthermographie auch ein geeignetes Verfahren für den Nachweis des Therapieerfolges bei Patienten mit TOS zu sein.

Thermographie bei Sinusitis-Patienten

P.Melnizky, T. Schartelmüller

Ludwig Boltzmann Institut für Physikalische Diagnostik (Vorstand: O. Rathkolb), Wien

Das Gesicht zeichnet sich durch eine besonders hohe Symmetrie der Temperaturverteilung aus. Entzündung der Nasennebenhöhlen können diese Temperaturverteilung stören.

Wir fertigten von Patienten mit klinisch und radiologisch nachgewiesener Sinusitis Gesichtsthermogramme an und verglichen diese mit jenen Ges under.

Nach 15-minütiger Akklimatisierung an eine Raumtemperatur von 23°C wurden unter Verwendung eines NEC San-ei Thermotracer Aufnahmen in der Front- und Profilansicht angefertigt. Über beiden Gesichts- und Nasenhälften sowie einer definierten Infraorbitalregion wurden 'regions of interest' eingezeichnet. Die mittleren Temperaturwerte wurden den Ergebnissen der klinischen und radiologischen Diagnostik gegenübergestellt und statistisch ausgewertet.

Insgesamt wurden 17 Patienten (9 Männer, 8 Frauen; Alter: 39 ± 13) und 15 Gesunde (10 Frauen, 5 Männer; Alter: 42 ± 12) in die Studie aufgenommen. Bei 12 Patienten fand sich eine Übereinstimmung der klinischen Befundung mit dem Röntgen. Die mittlere Temperaturdifferenz der beiden Gesichtshälften in der Frontalansicht (symptomatisch dominante bzw. rechte minus symptomärmere bzw. linke Seite) betrug für die Patientengruppe 0,13 ± 0,18°K und für das Kontrollkollektiv 0,05 ± 0,11°K.

Unsere Ergebnisse belegen einerseits die gute Übereinstimmung der klinischen und röntgenologischen Diagnostik sowie andererseits der IR-Thermographie (Überwärmung der symptomatischen Seite) und der Röntgenbefundung.

Infrared Imaging in Diabetic Foot Ulceration

J.R.Harding*****, D.F.Wertheim**, R.J.Williams**, J.M.Melhuish***, R.D. Banerjee***, K.G.Harding***

* Department of Clinical Radiology, St.Woolos Hospital, Newport, Gwent, NP9 4SZ (UK)

**School of Electronics, University of Glamorgan, Pontypridd, Mid Glamorgan, CF37 1DL (UK)

***Wound Healing Research Unit, University Department of Surgery, University of Wales College of Medicine, Heath Park, Cardiff, CF4 4XN (UK)

Diabetic foot ulcers present a difficult problem in clinical management because of increased risk of soft-tissue infection in diabetes plus impaired local blood supply due to diabetic vascular disease. Infection of diabetic foot ulcers has particular risk of involvement of the adjacent bone resulting in the serious complication of osteomyelitis. This needs early aggressive antibiotic therapy to avoid even more serious secondary long-term complications, but unfortunately clinical diagnosis and radiological examination may be unhelpful in early osteomyelitis, when antibiotic therapy is most effective. Furthermore the large number of patients plus the chronic nature of diabetic foot ulceration precludes routine investigation for early osteomyelitis by X-ray or isotope bone scanning in every case, for logistic, radiation protection, and cost reasons. This preliminary study has shown significantly increased temperature on infrared imaging, not only around the ulcer, but in the entire foot in patients subsequently confirmed radiologically as having early osteomyelitis.

Mitteilungen

D. Rusch

Sekretär der Deutschen Gesellschaft für Thermologie, e.V., Bad Nauheim

Der Günter-Bergmann-Preis 1998 der Deutschen Gesellschaft für Thermologie

Die Mitgliederversammlung der Deutschen Gesellschaft für Thermologie am 26. September 1997 hat den Günter-Bergmann- Preis für Thermologie beschlossen. Der Preis soll alle zwei Jahre, erstmalig 1998, verliehen werden.

Fristgerecht bis zum 31. August 1998 wurden drei Arbeiten eingereicht, welche die Statuten des Preises erfüllen: J. R. Harding et al.: Infrared Imaging In Diabetic Foot Ulceration (Europ. J. Thermology 8 (1998), 145; P. Melnizky u. T. Schartelmüller: Thermographie bei Sinusitis-Patienten (Europ. J. Thermology 8 (1998), 150; T. Schartelmüller, P. Melnizky u. B. Engelbert: Infrarotthermographie zur Evaluierung des Erfolges physikalischer Therapie bei Patienten mit klinischem Verdacht auf Thoracic Outlet Syndrome (Thermology international 9 (1999), 19).

Alle angeforderten Voten waren ebenfalls fristgerecht eingesandt worden. Der Vorstand der Deutschen Gesellschaft für Thermologie konnte somit in seiner Sitzung am Abend vor der Jahrestagung 1998 den ersten Träger des Günter-Bergmann-Preises für Thermologie anhand der abgegebenen Voten ermitteln. Obwohl keine der eingereichten Arbeiten ohne positives Votum blieb, war doch eine der Arbeiten nach der Zahl deutlich positiver bewertet worden, die Arbeit von J. R. Harding et al.

Als sehr positiv ist anzumerken, daß alle drei Hauptautoren der eingereichten Preisarbeiten im Rahmen des wissenschaftlichen Programms der Jahrestagung 1998 ihre Arbeiten vorgetragen haben.

Nach Abschluß der wissenschaftlichen Vorträge verlieh der Präsident der Deutschen Gesellschaft für Thermologie, Herr Dr. Engel, den Günter-Bergmann-Preis an Dr. Harding. Die auf Bitten der Gesellschaft durch Frau Karin Bergmann in Auftrag gegebene Glasplastik (Skizze in Europ. J. Thermology 8 (1998), 128) fand allgemeine Bewunderung.

Der Vorstand der Deutschen Gesellschaft hat mit dieser Preisverleihung in Celle die große Freude gehabt, die erste Verleihung des Günter-Bergmann-Preises in der Heimatstadt ihres langjährigen Schatzmeisters und Gründ- ungsmitglieds Dr. med. Günter Bergmann vorzunehmen.

Die nächste Ausschreibung des Günter-Bergmann-Preises erfolgt im Jahr 2000, dem Jahr der EXPO 2000 in Hannover. Die Deutsche Gesellschaft plant ihre Jahrestagung 2000 im Rahmen des Projekts KeimCelle Zukunft (Heilen im Dialog) der Stadt Celle durchzuführen. Es ist zu hoffen, daß sich wieder ausreichend viele Thermologen um den Günter-Bergmann- Preis für Thermologie bewerben.

Mitgliederversammlung der Deutschen Gesellschaft für Thermologie e. V. am 14. November 1998 in Celle, Steigenberger Esprix Hotel

Die Einladung zur Mitgliederversammlung ist am 8. Oktober 1998 an die Mitglieder versandt worden. Es waren anteilig mehr Mitglieder zur Versammlung gekommen als im Durchschnitt der letzten Jahre.

Der Präsident der Gesellschaft, Dr. Engel, eröffnet die Versammlung. In kurzen Berichten erinnert er an diejenigen Mitglieder, von deren Ableben der Vorstand Kenntnis erlangt hat. Zum Totengedenken erheben sich die Teilneh-

mer. Anschließend berichtet der Sekretär kurz über den aktuellen Mitgliederstand.

Im Bericht des Präsidenten nimmt Dr. Engel zu aktuellen Problemen der Thermologie Stellung. Die Thermographie ist weltweit im zahlenmäßigen Rückgang begriffen. Es ist nach Engels Worten traurig, daß die relativ rasch im Thermogramm auftretenden Krankheitszeichen nicht genutzt werden. Inzwischen haben Kolleginnen und Kollegen in Polen an- gefangen thermologisch zu arbeiten. Die Europäische Gesellschaft für Thermologie hält Kontakt zu Kollegen in weiteren Ländern, so in Tschechien, der Slowakischen Republik und Ungarn. Der Präsident berichtet mit Freu- de von dem laufenden Projekt von Francis Ring, die gesamte thermologische Literatur auf CD-Rom zu pressen. Die bisherige Sammlung der Literatur ist auch unter "http://www.glam.ac.uk/pages/IR_ARCHIVE/default.htm" einzusehen.

Dr. Engel berichtet dann über die Überlegungen des Vorstands zu den kommenden Jahrestagungen. Die Jahrestagung 1999 soll entweder in Dresden oder Leipzig stattfinden. Die Mitgliederversammlung entscheidet sich für Leipzig. Wegen der Tagung der japanischen Thermologen im Juni 1999 sollte die D.G.T eher im Herbst tagen. Tagungsort soll nach dem bisherigen Vorschlag das Parkhotel gegenüber dem Hauptbahnhof in Leipzig sein. Nach der Satzung der D.G.T. stehen für 1999 wieder Neuwahlen des Vorstands an. Im zeitlichen Zusammenhang mit der Jahrestagung ist ein Kurs in medizinischer Thermographie in Bad Liebenwerda vorgesehen. Das Ziel dieses und möglicher weiterer Kurse ist ein Zertifikat in Biomedizinischer Thermologie.

Im Jahr 2000 wird für die Feier des 20-jährigen Bestehens der Deutschen Gesellschaft für Thermologie eine Jahrestagung mit internationaler Beteiligung vorgesehen. Es ist geplant, die Tagung in ein Projekt der Stadt Celle einzubinden, welches im Rahmen der EXPO 2000 in Hannover durchgeführt wird. Dem gewünschten Vorhaben einer internationalen Tagung steht entgegen, daß dafür schon Italien im gleichen Jahr bestimmt ist.

Für das Jahr 2001 steht dann wieder eine internationale Thermologie-Tagung in Wien an.

Zum Schluß wählt die Versammlung noch zwei freiwillige Kandidaten zu den Kassenprüfern der Gesellschaft. Es sind die Mitglieder Dr. Hippchen und J. Bergmann, dem außerdem Dr. Kunz, langjähriger Kassenprüfer, seine Hilfe versprochen hat.

News in Thermology

AAT Meeting 1999 in May

The American Academy of Thermology invites anyone interested in the science or application of infrared imaging (thermology), especially but not limited to medical applications, to consider attending this conference. The meeting, is jointly sponsured by, the The American Academy of Thermology and Allegheny General Hospital. Medical thermal imaging, a technique which does not use ionising or magnetic radiation, is an inexpensive diagnostic test providing dynamic physiologic information. The recent advances in both infrared cameras and image processing,makes it ideal for utilization in the medical field.

Thermal imaging provides physiologic information on the skin circulation and thus of the autonomic nervous system. Thermal imaging has been established as an important test for the diagnosis of Complex Regional Pain Syndrome. It has extensive applications in other fields such as neurology, neurosurgery and orthopaedics (radiculopathy, peripheral nerve injuries, neuropathy and headache); Rheumatology and physiatry (joint disease, fibromyalgic syndrome and other myofascial pain syndromes), Cardiology and vascular disorders (open heart surgery, arterial disease, deep venous thrombosis), oncology (breast and skin cancer) and others.

Sections on basic thermographic technique and interpretation will be offered and a discussion of interesting cases.

Location

The meeting will be held at the Hyatt eRegency Pfer 66 Hotel in the resort town of Ft. Lauderdale, Florida. Often called the "Venice of America' because of it's many intricate canals,. the city is also noted for it's beautiful beaches, fine dining, fabulous shopping and relaxed atmosphere. Deep sea sport fishing and three to seven day cruises to the sparkling Carribean are avallable within minutes of the convention site. The outstanding Hyatt Regency Pier 66 Hotel is located directly on the unique lntracoastal waterway and less than five minutes from the above attractions. The hotel is offering a very special convention rate of $112 for a single/double room per night. Additional inforrnation will be included in the final brochure.

Hyatt Regency Pier 66 Hotel

2301 South East 17th Street Causeway

Ft- Lauderdale, Florida 3316, U.S.A.

Phone, 1 (954) 525-6666, Fax- 1 (954) 728-3541

Ft. Lauderdale has it's own international airport and easy connections from other entry points into the United States. The hotel is easily accessible by a ten minute taxicab ride from the airport.

For more information concerning the meeting, contact Allegheny General Hospital, Continuing Medical Education at

+1(412) 339-4952 or by fax at +1(412) 339-4952 or by fax at +1(412) 359-8218
E-mail- bheilman@aherf-edu,

Final course brochure and registration materials will be distributed in February 1999.

ABT Training and Exam Available at 1999 Annual Meeting

Preparatory sessions for membership in the American Board of Thermology (ABT) will be available at next year's annual meeting, to be followed by the ABT exam.

Eligibility requirements will change after the year 2000, so interested practitioners should notify AAT President Srini Govindan, M.D., (304)242-2503, fax- (304)242-2682, by Janua-

ry 31, 1999 to be included. Currently candidates need only be active members of AAT. Non-members may join the Academy and thus become Board-eligible.

President Govindan and AAT directors will assist eligible members in preparing for the Board examination with case studies and suggested reading. Members preparing for the AAT Board review can receive AAT 1997 and 1998 proceedings by contacting Dr. Govindan.

After 2000 only those meeting the following prerequisites may take the exam:

- 1.An M.D. or D.O. degree from a U.S. medical school or A.M.A. approved foreign medical school, with postgraduate residency training, and be Board-eligible or certified in neurology, physical medicine or rehabilitation, pain management, anesthesiology, surgery, oncology, radiology, occupational medicine or health care management, or have fulfilled a similar qualification;
- 2.Have two years active membership in the American Academy of Thermology; and
- 3 .Have completed 30 hours of continuing medical education (C.M.E.) credit which includes a minimum of 10 hours of Thermography, 10 hours of Neurophysiology (e.g., E.M.G. autonomic testing), and 10 hours of Pain Management, diagno-sis and treatment.

Components of the ABT review will include

- 1.The principles behind infrared imaging.
- 2.How to set up a lab
- 3.Quality assurance and means of implementation
- 4.Interpretation of results
- 5.How to write a report
- 6.Levels of reimbursement
- 7.Issues dealing with Clinical Applications, Forensic Medicine, Disability Medicine, AMA guidelines, and Permanent Partial Disability (PPD) Ratings
- 8.Clinical research opportunities in Thermography. Time will be allowed for this after the review course and during the conference.

Executive Council of the AAT Begins Term of Office

Srini Govindan, M.D. advanced to the position of ***President*** at the May 30 business meeting of the AAT's 27th Annual Conference. Dr. Govindan has his own practice at Neurodiagnostics in Wheeling, West Virginia. His specialties are neurology, headache and cerebrat blood flow. He has been a member of the Academy since 1983.

Vice President is **Robert Jamison, D.O.,** whose medical practice is located in Haddon Heights, NJ. He will become president in the year 2000. The offices of Secretary and Treasurer are presently vacant. Outgoing president, **Sheng Tchou, M.D.,** is now ***Cbairman of tbe Executive Council.*** Dr. Tchou is a psyiatrist in Johnson City, Tennessee.

Pierre L. LeRoy, M.D., retains his position as ***Chairman*** of ***the Budget and Finance Committee,*** and **Gerald S. Goldberg, M.D.,** as ***Cbairman*** of ***tbe Membersbip Committee.***

Dr. Jamison also continues as ***Chairman of tbe Professional Affairs and Education Committee***. J**ack E. Hubbard, Ph.D., M.D.**, is the ***Cbairman of Quality Control and Quantifications Committee,***and **Michael Anbar, Ph.D.,** of the ***Researcb Committee. Ex-officio Council Member*** and ***Chairman of tbe Nominating Committee*** is **Alfred P. Pavot, M.D.**

Newly appointed as ***Tecbnical Liaison*** is **Nicholas A. Diakides, Ph.D.** Dr. Diakides replaces Frederic Huffnagel, M.D. who was granted Emeritus Status. He is president of Advanced Concepts Analysis of Falls Church, VA - a consulting firm dealing with advanced defense research and development and health care technology.

Members who would like to serve on any of these committees are encouraged to contact the AAT office by phone at 703/938-6140 or fax at 703/938-1482, or the committee chairman. Council members' phone and fax numbers are:

Govindan	204/242-2503, fax: 304/242-2682
Hubbard	612/435-8516, fax: 612/435-8518
Jamison	609/546-1020, fax: 609/546-1441
Anbar	716/829/2742, fax: 716/689-3669
LeRoy	302/738-9543, fax: 302/738-4914

Diakides	703/914-9237, fax: 703/914-9237
Goldberg	954/797-7881, fax: 954/791-0031
Pavot	202/574-6141, fax: 202/574-7091
Tchou	423/431-2812, fax: 423/431-5548

Asian Pacific Conference of Thermology

The APCT´99, held in Nagaoka, Japan, in June 24-26,1999, is the second joint meeting of the Asian Pacific Federation of Thermo-l ogy (APFT) and the Japanese Society of Thermology (JST).APFT invites anyone interested in the science and technology of infrared imaging and thermological application in me- dicine to consider attending this Conference. The meeting is jointly sponsored by APFT, JST,Applied Medical Science ResearchFoundation, and Multimedia Center of Nagaoka University of Technology. Infrared imaging is a non-invasive, non-utilizer of radiation or magnetic fields, and remote sensing measurement technique in medical field. Thermal imaging provides not only physiologic but also anatomic and metabolicl information on skin and the surface of the living body. Recent advancement of infrared technology may provide much more new application in medical thermology. The aim of the conference is to present the most recent state of infrared imaging by distinguished experts and to communicate the application fields of thermology.

Conference Chairmen

lwao Fujimasa, M.D., Ph.D., Professor,
National Graduate Institute for Policy Studies
Tokyo,Japan
and
Jinich Matsuda, D.Eng.,Professor,
Nagaoka University of Technology
Niigata, Japan

Preliminary schedule

Sessions will begin at approximately 9:30 a.m. A detailed schedule will be included in the final announcement.

Location

The 2nd Conference of Asian Pacific Federation of Thermology will be held at the Multimedia Center of Nagaoka University of Technology in Nagaoka, Japan. The university is located at the west hill of Nagaoka City which is a traffic center at the coast of the Japanese Sea and within two hours on the new bullet train from Tokyo. Many hotels are available in Nagaoka city.

Abstract Submission Form

Abstracts to be considered for the Scientific Program must be typed, single-spaced on a A4 paper (size=210 mm x 297 mm; left and right margin=2 mm, and upper and lower margin=3 mm; titel of abstract, authors and their affillations should be printed on the top of the abstract.). All abstract submission must be accompanied by two photocopies.

Abstracts should report original material.

Please complete the following author´s information using a separate sheet of A4 paper. Please send it with an original paper and two copies. Faxes and e-mail will be accepted.

Deadline

Abstract should arrive before 15 March, 1999

Pre-Registration Form and Author´s information

Title of abstract

Corresponding author name

Address

Return

Fax:

Phone

E-mail

Return address

lwao Fujimasa, M.D., Ph.D., Professor
National Graduate Institute for Policy Studies
19 Mori Building.1-2-20 Toranomon, Minato-ku Tokyo 105-0001, Japan

E-Mail:goophy@grips.ac.jp
Phone:+81-3-3506-2529
Facsimile: +81-3-3506-2531

11th International Conference on Thermal Engineering and Thermogrammetry (THERMO)

from the 16th to 18th of June, 1999
in the OSSKI Center (Törley Palace), Budapest XXII (Budafok) Anna u.5.

Objectives

The developments of measurement theory and technologies help the energy-conscious design of thermal engineering equipment and processes as well as the better understanding of thermal phenomena in living organisms.

The Conference will cover topics both the field of theory and application including new mea-

surement concepts; transducer technique; thermal mapping; contact , optical and IR imaging; biomedical and biotechnological appli- cations; thermal informatics, automatic methods and systems for industrial energy management and process control; heat loss de- tection and analysis; heat and mass transfer, utilization of alternative energy, thermophysical properties and the common practice of thermal engineering.

This Conference will provide the latest information on the above topics together with a good opportunity for personal discussion among experts in the field of energy conservation, control of energy release and loss, protection of human environment, medical and veterinary applications, remote control through infrared sensors .

Organisation of the Conference

The language of the conference and abstracts is English. Oral presentations of papers and a poster session will be organized. Duration of each presentation will be limited to 15 minutes and additional time for discussion will also be provided.

Venue

The conference is hosted by the OSSKI Center (Törley Palace, Budapest, XXII. (Budafok), Anna u. 5.) located in the vicinity of the famous Budafok wine cellars. More information about the conference place and hotel accommodation will be sent after the arrival of the Registration Form.

Information

Application Forms should be sent to:

Dr.Irnre BENKÖ,

MATE Secretariat, House of Technology, III. 318., H-1372 Budapest, POB. 451., Hungary.
Fax: +361-153-1406 Phone: +361-332-9571.
E-mail: mate@mtesz.hu

For any further information please contact the following address:

Dr.Imre BENKÖ, Technical University of Budapest (BME), Department of Energy
(DoE) H-1111 Budapest, Müegyetem rkp. 7. D.208., Hungary,
office phone. +361-463-2568.
BME Fax: +361-463-1110,
BME telex: 225931 muegy h,
DoE Phonelfax: +361-463-3273 or -463-3272.
E-rnail:energy@eta.enrg.bme.hu

J.RichardHarding received the G.Bergmann Award 1998

Welsh radiologist J.R.Harding won the first G.Bergmann Award 1998 for the paper “Infrared Imaging in Diabetic Foot Ulceration”(published in the European Journal of Thermology 8: 145-149. 1998). The Award Committee stressed in selecting Hardings work, that all the submissions showed a high scientific level, and each of the three submitted papers deserved to be awarded. The manuscript on diabetic foot ulceration collected the highest number of votes.The Committee emphasized the impressive number of otherwise non diagnosed patients with osteomyelitis and its impact on costs of the health system, which can be substantially reduced by the use of infrared thermography in patients with diabetic foot ulcerations, as the main reason for their decision.

12th Thermological Symposium in Vienna May 15, 1999

The Austrian Society of Thermology will organize the 12th Thermological Symposium in Vienna on May15, 1999. The venue of this meeting is traditionally the SAS Palais Hotel.

The main theme of this symposium is Treatment Monitoring by Thermography. Invest-i gators from the Ludwig Boltzmann Research Institute for Physical Diagnostics will present their results of monitoring treatment in patients suffering from either thoracic outlet syndrome, fibromyalgia or algodystrophy. The organizers intend to invite Dr.J.R.Harding from U.K. to share his knowledge of thermographic treatment monitoring in patients suffering from diabetic foot ulcers with the audience.

Polish thermography experts has promised to participate in the meeeting and to present actual research reports.

In addition, any free papers will be accepted, when the arrive latest on March 31, 1999 at

OA.Dr.Kurt Ammer

Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik im Hanuschkrankenhaus, Heinrich Collinstraße 30, A-1140 Wien, Österreich

Tel: + 43 1 914 97 01 Fax: + 43 1 914 92 64
E-mail: KAmmer1950@aol.com

Call for abstracts

The 6th Congress of the International Society for Skin Imaging will be held on July 4-6, 1999 at the Royal Society London, United Kingdom. One of the topics is thermal imaging. Papers by Prof. F.Ring and Dr.K.Ammer are already included in the programme, but any other contribution on thermal imaging of the skin will be welcomed. Deadlinefor submissions is March 1st. For further details please contact the secreariat

HITEC (Hammersmith Hospital), Du Cane Road, London W12 OHS, UK.

Tel + 44 181383 1608,
Fax +44 181 383 1610
E-mail: hitec@rpms.ac.uk

Meeting of the Polish Thermology Society in Zakopane in September 1999

The second conference of the Polish Society of Thermology will be held in Koscielisko ka Zakopanego on September, 18.-19. The congress president Prof.Dr.A.Jung invites everyone active in thermology to participate in this meeting. For further information contact the conference secretariat at

Pediatric and Nephrology Clinic; Central Clinical Hospital, Military University, School of Medicine

Szaserow 128 str 00-908 Warsaw- 60, PL
Tel. + Fax: +4822 6817236

Veranstaltungen (MEETINGS)

1999

5-9 April 1999, Orlando

Part of SPIE's International Symposium on AeroSense

Infrared Technology and Applications XXV (ORo7)

Venue: Marriott's Orlando World Center, Orlando, Florida

Information: SPIE WEB- www.spie.org

15 May 1999, Vienna

12th Thermological Symposium of the Austrian Society of Thermology and the Ludwig Boltzmann Research Institute for Physical Diagnostics

Venue: SAS Radison Palais Hotel,

Main theme:

Treatment monitoring by thermography

Deadline for Abstracts: March 31, 1999

Information: OA.DR.Kurt Ammer

Ludwig Boltzmann Forschungsstelle für Physikalische Diagnostik im Hanuschkranken haus, Heinrich Collinstr. 30, A-1140 Wien

Tel: + 43 1 914 97 01 Fax: + 43 1 914 92 64

28-30. May 1999, Ft.Lauderdale

28th Annual Meeting and Board Review of the American Academy of Thermology

Venue: Hyatt Regency Pier 66, Ft.Lauderdale, Florida

Information: Srini Govindan M.D.

President, American Academy of Thermology

40 Medical Park, Suite 304

Wheeling; WV 26003

Tel +304 242 2503, fax: +304 242 2682

16-18 June 1999, Budapest

11th International Conference on Thermal Engineering and Thermogrammetry (Thermo)

Venue: OSSKI Center (Törley Palace) Budapest, XXII; (Budafok), Anna u.5

Conference language: English

Topics: General thermal engineering; theory of measurements; thermal informatics, thermo-CAD and its applications; industrial energy management and process control systems; practice of thermal engineering; infrar-red imaging science & technology, thermogrammetry; microscale thermal phenomena and sensing techniques, thermal defectometry; applied thermo-optics; thermophysical properties; heat and mass transfer; cooling of electronic components; heat exchangers; combustion, thermophysics of the environment; building services; environmental aspects of energy use; thermo-ergonomy and thermo-psychology; thermo-diagnostics, system analysis in thermo-biology; IR-imaging in biomedical and bioengineering applications; multidisciplinary topics

Deadline for abstracts: 15 October 1998

Scientific Committee:
Chairman: Dr. I.Benkö, Hungary
Secretary: I.Kovacsics, MSc, Hungary
Members: Dr.K.Ammer, Austria
Dr.F.Arinc, Turkey
Dr.T.Ayhan, Turkey
Dr.W.Bauer, Germany
Dr.I.Dincer, Saudi Arabia
Dr.S.Kakac, USA
Dr.L.I.Kiss, Canada
Dr.G.J.Köteles, Hungary
Dr.A.Lallemand, France
Dr.S.Mochzuki, Japan
Dr.L.Radonyi, Hungary

Dr.S.Svaic, Croatia
Dr.L.de Thibault de Boesinghe, Belgium
Dr.W.-J.Yang, USA
Dr.B.Wiecek, Poland

In formation: Dr.Imre Benkö
Technical University of Budapest (BME),
Department of Energy (DoE)
H-1111 Budapest, Müegyetem rkp 7.,
D.208 Hungary
office phone: + 361 463 2568
BME: Fax: +361 463 1110 BME telex: 225931 muegy h.
DoE Phone/fax: + 361-463 3273 or 463-3272
E-mail: energy@eta.enrg.bme.hu

24 - 26 June 1999 , Nagaoka(Japan)

AFPC' 99 - Asian Pacific Conference of Thermology

2nd Conference of the Asian Pacific Federation of Thermology and 31 st Annual Mee ting of the Japanese Society of Thermology

Main theme: Emerging New Era of Advanced Infrared Imaging

Venue: Multimedia Center *of* Nagaoka University of Technology

Jointly *sponsored by:*

International College of Thermology

Asian Pacific Federation of Thermology

Japanese Society of Thermology

Korean Academy of Medical Thermology

Applied Medical Science Research Foundation

Multimedia Center of Nagaoka University of Technology

In formation:

Professor Iwao Fujimasa, M.D., Ph.D.
Chairman AFPC'99

National Graduate Institute for Policy Studies
19 Mori Building
1-2-20 Toranomon, Minato-ku
Tokyo 105-0001, Japan

Tel: + 81 3 3506 2529 Fax: + 81 3 3506 2531
e-mail goophy@grips.ac.jp

4.-6. July 1999, London

6th CONGRESS OF THE INTERNATIONAL SOCIETY FOR SKIN IMAGING (ISSI)

Venue: The Royal Society, London, , United Kingdom

Topics: Imaging in the Diagnosis and Management of Skin Cancerm **I**maging Methods in Skin Pharmaacology , Measurement in Cosmetic Dermatology , Skin Surface Imaging, ELM , Ultrasound , MRI , Optical Tomography and Holography , Spectroscopic Imaging , Fluorescence Imaging ,Topometry, Profilometry, Interferometry, **Thermal Imaging** , Imaging the Microcirculation , Laser Doppler Imaging, Elasticity Imaging , Nuclear Imaging , Computer-assisted Image Analysis, Picture Archiving, Telemedicine, Computer Databases. Multimedia

Presidents:J.G. McVie (UK), RJ. Hay (UK)

Chairmen: J Bamber (UK), S. el Gammal (Germany), P. Mortimer (UK), F. Ring (UK)

Local Organizing Committee (UK):
K. Humphries (Secretariat), D. Cosgrove, P. French, R. Imhof, S. Young

Local Advisory Board (UK): C. Griffiths, C. Harland, R. Marks, R. Ott, J Rees

*International Scientific Board:*J. Bamber (UK), M. Burronio (Italy), A. di Nardo (Italy),S.el Gammal (Germany), K. Hoffmann (Germany), A. M. Kligman (USA),G.Nilsson (Sweden), H. Pehamberger (Austria), D. Perednia (USA), B. Querleux (France),F.Ring (UK), S. Seidenari (Italy),J. Serup (Denmark), W. Stolz (Germany), M.Stücker (Germany), H. Takiwaki Japan), L. Vaillant (France), A. Zemtsov (USA)

Organized with the support of. The Institute of Cancer Research, The Cancer Research Campaign

Under the patronage of.- The International Society for Digital Imaging of the Skin (ISDIS), Tne International Society for Bioengineering and the Skin (ISBS)

Secretariat (for ALL enquiries):
HITEC (Hammersmith Hospital),
Du Cane Road, London W12 OHS, UK.
Tel: +44 181 383 1608 Fax: +44 181 383 1610
E-mail: hitec@rpms.ac.uk

18.-19.September, Zakopane

2nd Congress of the Polish Society of Thermology "Thermovision in Medical Diagnostics"

Deadline for abstracts:

Venue: DW "SYWARNE"

34-511 Koscielisko k.Zakopanego

Ul.Sywarne 32

Information:
Pediatric and Nephrology Clinic,
Central Clinical Hospital, Military University,
School of Medicine
Szaserow 128 str
00-909 Warsaw-60, PL

Tel/fax +48 22 6817236

29.-30.September, 1999, Venezia

5th International Workshop on Advanced Infrared Technology and Applications

Venue: CNR-ISDGM, Palazo Papadopoli, S. Polo 1364, Venzia, Italy

Topics:
Advanced technology and applications, sensors and materials, thermal non-destructive-testing, applications to works of art, buildings monitoring and maintenance, thermofluid dynamics, enviroinment, standards

Language: English

Deadline for abstracts: February 12, 1999.

Abstracts written in English should be sent to

P.G.Bison, CNR-ITEF, corso Stati Uniti, 4

35127, Padova, Italy

or by e-mai:l 5AITA.abstract@itef.pd.it

Or by fax + 39 49 829 5728

Information

A.M.Felgentreff, Fond.G.Ronchi-Firenze

P.G.Bison, CNR-ITEF, corso Stati Uniti, 4

35127, Padova, Italy

Tel. + 39 49 829 5735, Fax + 39 49 829 5728
E-mail: 5AITA.abstract@itef.pd.it

Webpage: http.// www.itef.pd.cnr.it/5AITA

13-16. October, 1999

21st Annual International Conference of the IEEE Engineering in Medicine and Biology Society in conjunction with Annual Fall Meeting of the Biomedical Engineering Society

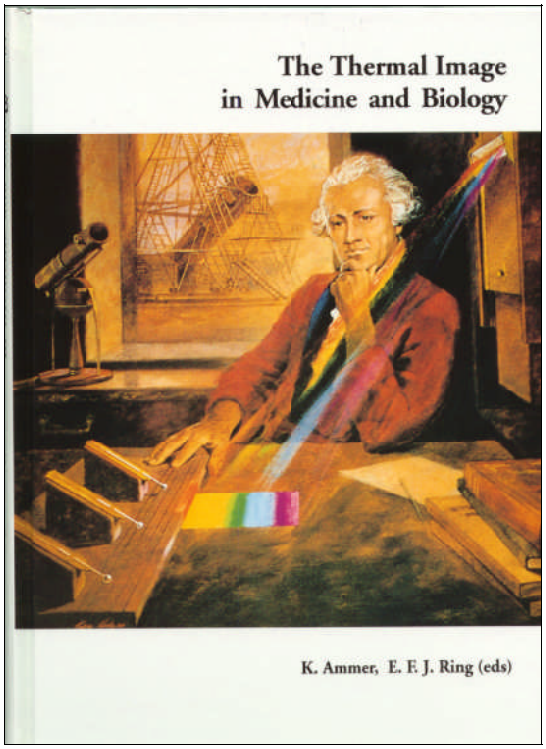
*Venue:*Hyatt Regency Atlanta, Peachtree Center, Atlanta , Georgia

*Information*http://bmes-embs99.gatech.edu

Index, Volume 8, 1998, European Journal of Thermology

Papers

Autoren



The Thermal Image In Medicine & Biology

1995, ISBN 3 900466 57 2
240 pp. plus XVI colour plates

ed. K.Ammer, EFJ.Ring

Thermal Imaging, Microwave Detection
Image Processing, Thermal Image Applications
Recent advances in medical thermography
Thermal physiology and the skin
Veterinary thermography
Medical applications of thermal imaging
Vascular applications.

This book, based on the proceedings of an international conference, provides the most up to date review of the current state of the art in thermal imaging. The clinical applicatons include vascular skin reactions, varicosed veins, deep vein thrombosis and Raynaud's Phenomenon. Lumbar disc herniation, post surgical evaluation of the knee and the hand (carpal tunnel syndrome), tennis elbow and thoracic outlet syndrome are also described.
The methodology itself and comparative studies with other techniques such as ultrasound, CT and MRI make this a practical manual for the physician or technologist employing these investigations.

Only available from The European Association of Thermology, order below at the direct sale price of **$50 U.S. or 500.- Austrian Schillings** to the following account 965 023 054 at Bank Austria, No 20151 in Vienna, Austria. Price includes mail in Europe, all other destinations add $10 or 120.-Austrian Schillings.

ORDER

The Thermal Image In Medicine & Biology .....copy/ies

Name..... fax no.....

Address.....

.....country.....code/ZIP.....

amount due.....

I wish to subcribe to **Thermology international**
(1 yr subscription 700.- Austrian Schilling or US $ 70.- including mail costs)
1 yr subscription.....

TOTAL PAYMENT TO THE EUROPEAN ASSOCIATION OF THERMOLOGY.....

send with payment (international order or proof of bank transfer) to
Dr.Kurt Ammer, European Association of Thermology
Hernalser Hauptstr. 209/14, A-1170 Wien, Österreich
Bank Austria, Vienna, Austria, bank number: 20151,
account :European Association of Thermology, account number: 965 023 054