Posters

OBSERVATION OF PERIPHERAL CAPILLARY BLOOD FLOW IN PROXIMAL NAIL FOLDS AND THERMOGRAPHY

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INTRODUCTION: We could non-invasively analyze capillary blood flow velocity of the proximal nail folds (cuticles), by using JMC's peripheral capillary observation unit M320 (JMC Inc., Kyoto). We could easily observe many capillaries and erythrocyte movement in the capillary vessels on a PC monitor with patients. M320 software required only a 10-second captured digital video file for analysis. We evaluated the effectiveness of capillary observation as a clinical marker and nutritional education of diabetic triopathy.

METHODS: The study was conducted with 15 diabetic patients (DM) and 30 non-diabetics (non-DM). In a climate-controlled room (25 degrees Centigrade, 50%, no wind), we took a thermographic picture of a finger. We observed the capillaries of the proximal nail folds and analyzed the capillary blood flow velocity, blood flow volume and capillary diameter. We also examined the relationship between the finger temperature, blood pressure and blood biochemical variables with them. We utilized Peason's correlation coefficient-test and non-paired t-test for statistical analysis ($P < 0.05$).

RESULTS: The capillary blood flow velocity had a positive correlation with the systolic blood pressure ($p<0.05$, $R=0.40$, $N=28$), and a negative correlation with HbA1c ($p<0.05$, $R=0.72$, $N=18$).

The mean capillary blood flow velocity of DM group (76.9 ± 12.2 μm/s) was slower than that of the non-DM group (93.0 ± 14.5 μm/s). The mean capillary blood flow volume of DM group (10910 ± 3892 μm3/s) was significantly less than that of the non-DM group (14821 ± 5065 μm3/s). Though we didn't find the correlation between the mean capillary blood flow velocity and finger temperature, it was found that the cases who had extremely slow capillary blood flow velocity showed low finger temperature. Further study is needed for more details.

DISCUSSION: It was shown that the observation and analysis of capillary blood flow attracted patients' interests, and it may help patients continue their dietary and exercise therapy.

SYMPATHETIC NERVE BLOCK EFFECTS OF PHOTOTHERAPY NEAR STELLATE GANGLION

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INTRODUCTION: Stellate ganglion block therapy had been often used to reduce pain and increase blood flow for the patients suffering Raynaud's phenomenon and shoul- der hand syndrome (RSD in stroke). But recently we could rarely apply the treatments by the risk of puncture. Infra- red or Xenon phototherapy to the stellate ganglion had been demonstrated to reduce pain and increase blood flow not invasively, and the effects were similar to the stellate ganglion block therapy. We studied physiological effect by the phototherapy near the neck stellate ganglion.

METHODS: The healthy volunteers were irradiated at the left neck stellate ganglion by polarized infrared light for 10 minutes after cold water immersion test (15 Degrees Centigrade, 3 minutes).Polarized infrared light irradiation system is Super Lizer HA-550 and 70%power,1 second irradiation 2 seconds resting cycles. And the irradiation group of eleven were irradiated at the right neck stellate ganglion by polarized infrared light irradiation for 20 minutes, And the control group of eleven were treated for 20 minutes use the same irradiation instrument that the light were completely obstructed. We analyzed the blood laboratory test and the temperatures of limbs and perspiration quantity of palm and blood pressure before and after of irradiation.

RESULTS: The irradiated side temperature increased. The perspiration quantity of irradiated side was decreased ($p<0.05$) and the peripheral temperature of bilateral upper and lower limbs increased. The leukocyte counts decreased ($p<0.01$).We have not find statistical significance blood pressure change.

CONCLUSION: It was considered that the effect by the polarized infrared light irradiation for near the neck stellate ganglion was similar to the sympathetic nervous ganglion block.

TIME TO STABILIZATION OF THERMOGRAPHIC IMAGES AT REST

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INTRODUCTION: The application of thermography in professional practice and researches requires a series of procedures to obtain images that should be standardized. One point to highlight from these methods is the time required for acclimatization evaluated in a controlled environment.

OBJECTIVE: Thus, the purpose of this study is to identify the time needed at rest to equilibrate the skin temperature (ST) in men and women of college age.

METHOD: Forty-four subjects participated in the study, 18 men (22.3 ± 3.1 years) and 26 women (21.7 ± 2.5 years). Thermographic images were collected using a thermal imager, a total of 44 photos in a period of 20 minutes in each was assessed. ST was evaluated at each the points of analysis, which included the minutes 0, 2, 4, 6, 8, 10, 12, 14, 16, 18 and 20. The body regions of interest (ROI) analyzed include the hand, forearm, arm, thigh, leg, chest and abdomen. We applied the Friedman test with Dunn's post hoc, in order to determine the time required to equilibrate the ST. The Mann-Whitney test was used to compare age, BMI, fat percentage and temperature variations between men and women. A significance level of $p<0.05$ was used in all calculations.

RESULTS: The results showed that women had greater temperature variations than men over time ($p <0.01$). In men, only the body region of the abdomen showed significant difference ($p<0.05$) during the period examined, both in the anterior and posterior portion of the body. In women, the anterior abdomen and thighs (right and left) showed significant differences ($p<0.05$), while the right hand, left hand, right forearm, left forearm and abdomen had significant differences in posterior of the body.

CONCLUSION: Based on these results, we can conclude that the time required to equilibrate the ST in men and women of college age is variable. For analysis of the whole body, it is recommended at least 10 minutes for both genders.

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THERMAL RESPONSE OF THE SKIN TEMPERATURE ON MUSCLE AND JOINT BODY AREAS AFTER STRENGTH TRAINING BY INFRARED THERMOGRAPHY

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INTRODUCTION: There is no doubt that core or central temperature has a direct relationship with the exercise intensity. Some studies focused on measuring the central thermal response. However it is also interesting to investigate the thermal response of skin temperature after exercising. Between many reasons, it could provide important information about the recovery status -making possible to assess when the athletes are completely recovered as well as determining the influence of exercise on skin temperature.

OBJECTIVE: The purpose of our study is to determine by Infrared Thermography (IRT) the evolution of skin temperature for muscles and joints areas after strength training, besides to evaluate the thermal asymmetries.

METHODS: A total of fourteen physical active males (age: 21.44±2.64 years; height: 1.78±0.05 m; weight: 73.23±7.63 Kg), exercising at least 3 times per week, took part of the study. They did not report any diseases, consumption of medicaments, drugs, alcohol or tobacco the hours prior to the test. Subjects were asked to avoid a list of skin influence factors concerning daily activity and habits.

The study was conducted in three stages: the first one corresponded to a familiarisation period where the objectives, requirements and right technique of the exercises were described to the subjects, as well as the collection of anthropometrical data from the sample. The second one consisted of the performance of a 1RM (1-repetition maximum) of each exercise. Finally, the third stage consisted of hypertrophy training.

The training program started with a 5-minutes warm-up in cycle. The same order for exercises were followed for all participants, starting with bench press, leg press (main exercises), and followed by flat bench cable fly and leg extension (more analytic). Before each exercise, subjects did from 6 to 10 repetitions with light load to check the right technique and rhythm of execution. All the participants performed 4 x 10 rep (70% of 1RM) of the four exercises with 90" between sets and 3' of resting among exercises. Participants were instructed to perform the movement at a rate of 2:2 (2 seconds eccentric - 2 second concentric phase). All subjects were followed during the whole training season, providing them with real-time feedback about velocity and movement angle on each exercise. Immediately after the last repetition of leg extension, all subjects were to the acclimated room to do the thermography images.

Ten series of four thermograms (Anterior and Posterior of the Upper and Lower body) were registered before the exercise (B), immediately after (A) and once each hour during the eight following hours after the workout ("A+1" to "A+8"). Maximal, minimal, average and standard deviations of the temperatures from 24 anatomical Regions of Interest (ROI) were obtained from the thermograms using Termotracker software (Pemagroup, Spain). The thermographic analysis of the data followed the patterns set by Gomez Carmona et al. (2010) patented pending protocol. After the training trial, subjects remained in the room during the 8 following hours with a constant temperature between 18.5ºC and 21.0ºC. The statistics treatment consisted on a descriptive analysis, as well as an ANOVA and Tukey test to check the "time" factor with a significance value of $p < 0.05$.

RESULTS: In table 1 averaged temperatures and standard deviation are presented, taken from the analysis of joint areas from the baseline moment before the training, immediately and 8 hours after the trial, likewise the ANOVA result considering the ten time thermal data recorded. In table 2 the same results are presented for the muscles regions.

Table 1
Averaged temperature and standard deviation in joints ROI before, immediately and 8 hours after strength training.

RCI	**RIGHT**				**LEFT**			
	Rest	**After Exercise**	**8 h Recovery**	*P*	**Rest**	**After Exercise**	**8 h Recovery**	*P*
SH-F	31,98 ± 0,65	31,57 ± 0,83	32,38 ± 0,46	0,000	32,03 ± 0,66	31,66 ± 0,86	32,36 ± 0,59	0,010
SH-B	30,94 ±0,83	29,96 ± 1,23	31,32 ± 0,64	0,000	30,91 ± 0,86	29,91 ± 1,28	31,29 ± 0,75	0,000
Knee-F	28,31 ± 1,13	27,61 ± 1,23	28,32 ± 1,01	0,303	28,31 ± 1,24	27,43 ± 1,01	28,34 ± 1,20	0,132
Knee-B	31,00 ± 0,68	29,01 ± 0,91	30,99 ± 0,67	0,000	3,15 ± 0,79	29,33 ± 0,81	31,10 ± 0,71	0,000
Elbow-F	31,82 ± 0,71	31,86 ± 0,52	32,10 ± 0,63	0,850	31,77 ± 0,67	31,75 ± 0,56	32,00 ± 0,64	0,691
Elbow-B	28,95 ± 0,80	29,61 ± 0,69	29,42 ± 0,77	0,300	28,92 ± 1,00	29,67 ± 0,66	29,20 ± 0,97	0,341

SH = Shoulders; F = Front body ; B = Backs body

Table 2
Averaged temperature and standard deviation in muscles ROI before, immediately and 8 hours after strength training.

RCI	**RIGHT**				**LEFT**			
	Rest	**After Exercise**	**8 h Recovery**	*P*	**Rest**	**After Exercise**	**8 h Recovery**	*P*
Pectoralis	31,78 ± 0,54	31,04 ± 1,12	32,39 ± 0,58	0,000	31,75 ± 0,58	31,08 ± 1,09	32,36 ± 0,58	0,000
Lat-Dorsi	31,12 ± 0,66	29,35 ± 1,15	31,74 ± 0,71	0,000	31,19 ± 0,66	29,44 ± 1,20	31,79 ± 0,69	0,000
Arm F	31,52 ± 0,66	31,47 ±0,70	31,84 ± 0,64	0,707	31,46 ± 0,70	31,48 ± 0,65	31,73 ± 0,71	0,847
Arm B	29,32 ± 0,97	29,09 ± 0,76	29,99 ± 0,77	0,026	29,27 ± 0,99	29,16 ± 0,76	29,92 ± 0,86	0,126
Leg F	29,68 ± 0,77	29,67 ± 1,01	30,06 ± 0,67	0,068	29,56 ± 0,76	29,63 ± 0,96	29,96 ± 0,66	0,120
Leg P	30,23 ± 0,93	28,65 ± 1,06	30,90 ± 0,71	0,000	30,25 ± 1,04	28,68 ± 1,09	30,90 ±0,71	0,000

Lat-Dorsi= Latissimus Dorsi; F = Front body ; B = Backs body

DISCUSSION: Of the 24 Regions of Interest (ROI) evaluated, in 13 (54%) of them a significant difference was found through the time. It could indicate specific thermal responses depending of the analyzed body area. Concerning joints areas, there is a tendency of skin temperature decrease after the training (presented in 9 of the 12 ROI). After eight hours of recovery, the temperatures were slightly higher in 10 of the 13 ROI compared to the rest condition. Asymmetries between body areas were very small. The thermal response of muscles regions also decreased immediately after the training in contrast to the rest condition, with an upward curve along the eight-hour recovery, being still warmer at the end of this period in comparation with the rest condition. There was a bilateral thermal symmetry condition in all muscle regions evaluated excepting for the posterior muscles of the right arm, which have a significantly difference.

CONCLUSION: Skin temperature presents specific responses depending on the ROI studied. There is a clear tendency to maintain a thermal symmetry response. Both the joints and in muscles regions, the temperature tends to decrease after the strenght training, but never with a greater difference than 2°C. In addition, after eight hours of recovery the general thermal response tend to be warmer as the rest condition, but not more than 1ºC.

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PHYSIOLOGICAL AND PHYSICAL ASPECTS OF CUTANEOUS COOLING IN HEAT STRESSED HUMAN

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One expected effect of global warming is a higher frequency of more intensive heat waves, in southern regions as well as in northern. This will lead to a higher incident of heat related illness and death. Immediate and fast cooling is essential for reducing morbidity and mortality. In the Swedish health care system there are no guidelines for the initial care of people with heat related illness. The objective with this study was to gain deeper insight into human thermoregulation, focusing on the cutaneous circulatory response during cooling, identifying factors important for effective cooling and eventual risks for overheating. The methods used were literature review and heat balance equations. The results show that the human thermoregulation is of complex nature and is primary controlled via the cutaneous blood flow. This regulation is not yet fully understood Effective methods for cooling are; whole body immersion in circulating cold water, wetting of the skin with cold water and fanning. Water temperature for optimal cooling is yet not established. Heat balance equations established that best cooling effects were obtained via evaporation and convection. The wetted (water or ethanol) body area should be as large as possible and a high fan speed should be used directed across the body's longitudinal direction. Preferably, the skin should have a profuse blood circulation. Risk groups for exertional heat stroke are for example athletes, military and rescue personnel. The classical form of heat stroke usually occurs among the elderly, small children, chronically ill, and the physically or mentally disabled. Risk factors besides hot weather and high humidity are for example physical exertion, infection, certain drugs, social isolation, residing at an institution and lack of air conditioning. Subsequently, the results of this study lead us to recommend the following treatments, based on the individual's health condition: Total body immersion in cold circulating water or placing the individual in an airy hammock and spraying water continuously over the whole body whilst fanning. In summary, a larger assort of research is needed concerning heat related illness and the effects of different methods of cooling.

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ASSESSMENT OF FEVER FOR INFECTIONS CONTROL BY USING THERMOGRAPHY IN JAPAN

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INTRODUCTION: In order to control for infections of a new type influenza and severe acute respiratory syndrome, the thermography is applied to monitor the patients with fever caused by the infection. However, the evidenced-based cut-off level of the thermographic index to discriminate the patients with fever from healthy people is yet to be established. Therefore, we compared the facial temperatures of the patients with fever and those of healthy volunteers, which are measured by the diagnosis standard advocated by the Japanese Society of Thermology, and the assessment for infectious control by using thermography has been reconsidered.

METHODS: Thermographic examinations were performed on 50 cases of healthy volunteers, 16 cases of patients with influenza type A and 2 cases with influenza type B. We performed acclimatization of subjects for 20 minutes in the environment of room temperature at 25.0-26.0°C and 50% of humidity. The axillary temperature was measured by a clinical thermometer. This study was performed under the approval of the ethical committee of Hyogo University of Health Sciences, and all human samples were obtained from whom written informed consents were obtained.

RESULTS: 1. The comparison between the facial thermographies of healthy volunteers and those of the patients with influenza: The facial temperatures of the healthy volunteers were observed as follows, i.e. forehead at 34.7 ± 0.4°C, right cheek at 34.1 ± 0.6°C, left cheek at 34.1 ± 0.6°C, nose at 34.5 ± 1.0°C and chin at 34.2 ± 0.6°C. On the contrary, the facial temperature of the patients with influenza were observed as follows, i.e. Forehead at 36.3 ± 1.9°C, right cheek at 36.2 ± 1.8°C, left cheek at 36.4 ± 2.1°C, nose at 36.4 ± 1.7°C and chin at 36.5 ± 1.8°C. The facial temperatures of the patients with influenza demonstrated significantly higher than those of the healthy volunteers ($P<0.05$, Welch's t-tests).

2. The correlation between the facial thermography and the axillary temperature measured by a clinical thermometer in the patients with influenza: The significant correlations were found in forehead ($R=0.57$, $P=0.04$), right cheek ($R=0.54$, $P=0.04$) and chin ($R=0.67$, $P=0.01$), while the correlations in left cheek and nose were not significant (Spearman's correlation coefficient by rank test).

DISCUSSION: When the facial temperature of the traveler was higher than cut-off level in quarantine office, the officer had been judging them to be positive with fever. This cut-off level, however, is has not been scientifically set by the data of patients with fever. In this study, the facial temperatures of the patients with influenza showed higher than that of the healthy volunteers, whilst the axillary temperature does not necessarily correlate with facial temperature. It might be difficult to detect patients with fever by using cut-off level only. The current study suggests that the new accurate evidence-based standard for the detection of patients with fever needs to be constructed for avoiding future pandemic.

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THERMOGRAPHIC PROTOCOL OF HC-FMUSP: PUBALGY

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INTRODUCTION: The mechanical pain in the groin area presents an important and often confusing clinical dilemma. This is especially true in osteitis pubis, an inflammatory condition affecting the pubic symphysis.

The osteitis pubis (pubalgia) is a syndrome characterized by inflammation of the pubic symphysis pain in this region that produces and / or in the tendons of the adductors.

The first citation in the literature was made by Beer (1924) as a result of a complication of urological surgery. Currently, despite being relatively benign, has been recognized as a potential source of pain in athletes and have high morbidity, destroying careers at the peak of their performance or on the rise.

The infrared image (IRTG) is used since 1990 in various diseases, being non-invasive diagnostic method, non-radiative and non -ionizing, easy to perform and rapid response, able to quantify objectively, image, local inflammatory reactions of the musculoskeletal system plays an important role in monitoring the inflammatory activity and therapeutic evaluation.

Patients with pubalgia complain of dull pain, nonspecific bilateral pelvic throughout the region of the symphysis pubis, in the lower abdomen, groin and buttocks at the root of the thigh and inserts on muscle-tendon stiffness and occasionally neighbors. This pain is aggravated with the same efforts and relief with rest.

There are many causes of pubalgia, for example:
- Inserting the proximal enthesopathy average adduct
- Loss of strength of the abdominal wall or inguinal canal
- Changes in the morphology of the hip joint
- Fracture of the ischio-pubic branch of the femoral neck or
- Conflict of a space industry nervous
- Tumor formation in the groin
- Crural or inguinal hernia
- Endometriosis

METHOD: Thermographic examinations performed in patients with symptoms of pubalgia in order to record standard protocol.

The IR thermography (IRT) should be performed without prior manipulation of the patient (physiotherapy, acupuncture, massage, etc..) 12 hours prior. In the case of female patients to prevent menstrual period no interference pattern termovascular.

Report to the patient throughout the procedure and provides informed consent to be signed by the same. You must also get a brief history of the disease and record of examinations as well as examination of the skin (varicose veins, skin folds, wounds, bruises, tumors, etc ...)

The examination must be performed at room temperature between 20 and 21° C and the patient should be acclimatized and it should remain naked for 10 to 15 minutes without touching, rubbing or pressure.

Since there is a local inflammatory reaction, preferably carries it from 09:00 to 12:00 am. Do not smoke until 90 minutes before the exam. Perform sensitivity test standard 24-34 ° C Preferably keep two identical images reproducible.

As for positioning, leaving the patient walk and record whole-body imaging (front and back) then the pelvis (anteroposterior, posteroanterior, D and E and oblique, MMII face internal and external). Complete the examination record of the pubic region.

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TEMPLATED MODEL FOR HAND MEDICAL THERMAL IMAGE STANDARD ANALYSIS

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INTRODUCTION: Medical thermal images of hands provide clinical information about their physiological state. Despite all healthy humans have two hands with five fingers each, these limbs are characterized of having complex shape, which differ slightly within subjects such as their size. It makes is difficult to execute an accurate analysis. A standardization method is needed to perform an accurate comparison or average of several images.

METHODS: The method used in this experiment defines a geometrical approximate shape template model based on an average shape of hand. Using anthropometric reference measurements with 38 control points delineating each hand areas of interest composed of triangles (figure 1).

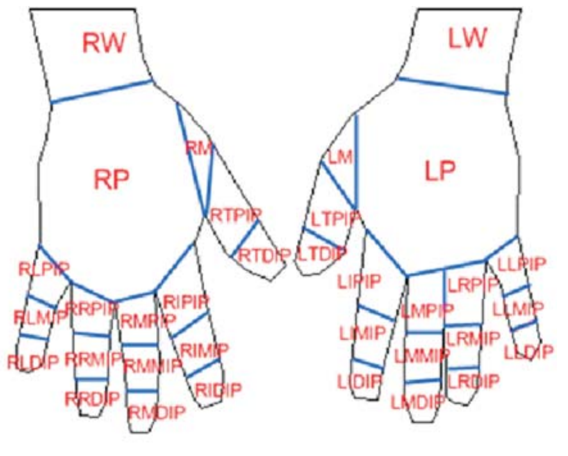

Figure. 1
Hands model with areas of interest

For the translation of pixels information within the areas of interest from original thermal images to the resultant standardized images, a translation algorithm based on warping triangulation through barycentric coordinates was used (figure.2).

RESULTS: The templated model allowed scaling and alignment of thermal images without scrambling the original data between

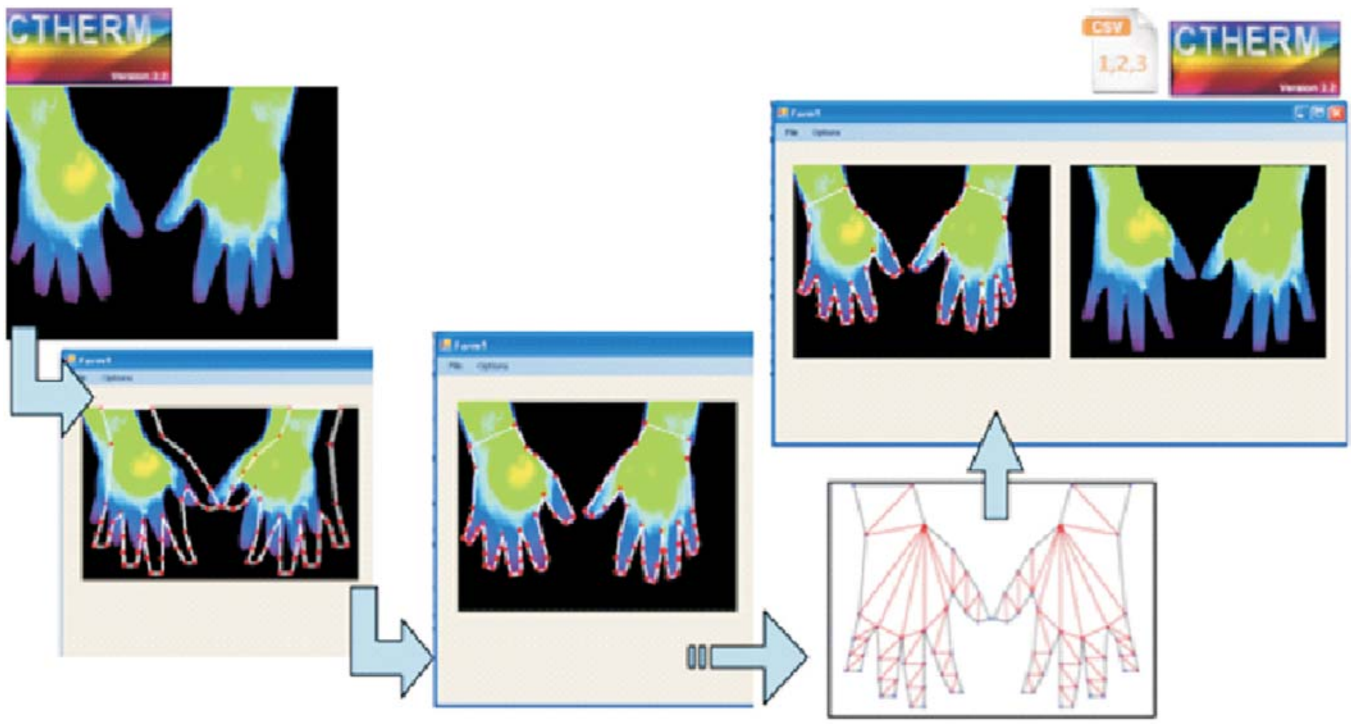

Figure 2
Method used in the experiment

different anatomical areas in an average time per image of 1.72 seconds. This simple process of warping thermal images presented an accuracy of 98% within the studied 1200 images. The calculated error between users of the developed application was inferior to 1% within the tested 12 users.

Discussion: Standardising several hand images is possible using this technique along with extended statistical evaluation, discrimination and balancing of groups of images with minimal processing time. However, work future work is needed in the automatic discovery of the areas of interest delineation control points.

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THE EFFECT OF DIFFERENT VIBRATION EXERCISE FREQUENCIES IN THE SKIN TEMPERATURE OF LOWER EXTREMITIES IN HEATHY SUBJECTS

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INTRODUCTION: Vibration exercise has been increasing used for leisure, sport and clinical settings, however their effects in blood flow and consequently in skin temperature remains unknown. The aim of this research is to study the impact of acute exposure to different vibration frequencies of whole body vibration in the skin temperature of the lower extremities in healthy subjects.

METHODS: The skin temperature of twelve healthy and untrained subjects was accessed using thermography, before and after exposure to vibration exercise with different vibration frequencies. A standard capture protocol was followed for image recording, subject, examination room and equipment preparation. The mechanical stimulation was provided by the Power Plate® with parameters set at frequencies of 35Hz and 40Hz, high amplitude (5-6mm), and therefore a peak acceleration of approximately 7g, for 5 minutes.

RESULTS: The analyzed regions of interest mean temperature increased in the lower legs. In all other regions of interest there was a decrease in the mean temperature in both vibration exercise frequencies.

DISCUSSION: The obtained results demonstrated that the exposure to 5 minutes of vibration (35Hz and 40Hz) in a single session has an effect in the skin temperatures of the lower extremities. This should take in consideration before vibration exercise prescription since decreased microcirculation of the lower extremity has been reported as a complication of ageing and disease processes such as diabetes. The results of this investigation can be used as a reference for assessing future research in specific pathologies affecting the lower limbs.

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CORRELATIONS BETWEEN QUANTITATIVE SENSORY TEST AND INFRARED THERMOGRAPHY IN LOW BACK PAIN PATIENTS - A PILOT STUDY

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BACKGROUND: Infrared Thermography (IT) has been proposed as a potential tool to assess musculoskeletal pain. However, there is a paucity of studies evaluating the correlations between low back pain, trigger points (TrP) and thermogram data.

METHODS: Thirty patients with primary low back pain (mean pain VAS> 30mm) and active TrP were included. They filled out the first part of the Brief Pain Inventory and underwent low back IT and mechanical quantitative sensory testing (mechanical detection, pain and supra-threshold-MDT, MPT, MSupra) of four points marked on the skin: the most intense pain location (MIPL) as pointed by the patient, its mirror area in the contralateral side (MIPL-mirr); the skin area over the main active trigger point (MATP) and its mirror area (MAPT-mirr). MIPL was central (MIPLA-C) when located + / - 1 cm from the midline and lateralized (MIPL-L) when > 1 cm. IT: Patients were evaluated unclothed, two meters away from the camera in a 22° C room (A320, FLIR, USA).

RESULTS: Twenty-eight patients were included (47 years, 22 female; VAS = 51 mm). MIPL-L was lower than the MIPL-C [40.0 (12-93) vs. 69.2 (34-90); p = 0.009). MSupra in MIPL-C was more intense than in MIPL-L (81.6 +/- 15 vs. 66.0 +/- 20.1; p = 0.049). The difference between MIPL and MIPL-mirr MSupra scores correlated to the IwVAS score (rho=0.51). MIPL and MATP X and Y coordinates showed high correlation (rho=0.76 and 0.50). Temperature on MIPL and MTPL correlated (rho=0.83).

CONCLUSIONS: Centrally located pain was more intense and presented higher mechanical hyperalgesia than lateralized pain. The area of maximal pain was spatially close and presented similar temperature as the area over the MATP.

THE EXTENT OF CONVECTIVE COOLING

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INTRODUCTION: Just as wind cools down one's skin when exposed, it also cools down a hotspot on electrical systems, especially those brought about by I^2R losses. A good rule of thumb that's been used in industry for many years is that a 16km/h (10mph) wind can reduce a hotspot's temperature by up to 50% and a 24km/h (15mph) wind can reduce a hotspot's temperature by up to 60%. Do these "rules" still apply to the thermography industry? The problem with these "rules" is that it does not mention anything about the hotspot temperature. Does this means that the same results would be obtained irrespective of the hotspot temperature?

The cooling effect of convection can be seen as the "wind chill" of non-living objects. The rate at which convective cooling occurs depends on Newton's law of cooling:

$$Q = h \times A\Delta T$$

Where:

Q= Heat energy in Watts or Btu/hr

h= Convective heat transfer coefficient

A = Area

ΔT = Temperature difference

METHODS: To test Newton's law of cooling and the rule of thumb a relatively simple experiment were conducted. For the experiment two heat sources of similar type, at different temperatures, were exposed to the same wind conditions for the same duration of time. The temperatures of the heat sources were randomly selected and the wind speed varied from 5km/h (8mph) to 30km/h (48mph). During the experiment, thermal images were taken every minute over a 10 minute period of which the wind was forced towards the heat sources

RESULTS: The normal reaction would be that a hotter heat source will loose more temperature compared to a colder heat source when exposed to convection for the same period. This is true if we consider only °C lost. This can be seen in table 1.

Table 1
Temperature loss of heat source X and Y.

	av. wind speed in km/h	T at 0 minutes in °C	T at 10 minutes in °C	T loss in °C	% T loss
Heat source X	7.63	496.00	447.90	48.10	9.69%
Heat source Y		248.00	210.47	37.53	15.22%
Heat source X	10.25	494.53	431.20	63.33	12.75%
Heat source Y		253.13	199.40	53.73	15.38%
Heat source X	15.19	497.30	418.90	78.40	17.85%
Heat source Y		251.27	186.17	65.10	26.18%
Heat source X	18.50	495.40	396.10	99.30	21.65%
Heat source Y		243.93	178.80	65.13	26.39%
Heat source X	22.67	496.17	384.63	111.54	24.61%
Heat source Y		243.27	172.50	70.77	30.20%
Heat source X	28.18	498.17	365.93	132.24	28.54%
Heat source Y		252.10	167.77	84.33	35.27%

CONCLUSION: For this experiment the hotter heat source temperature were reduced by 17.9% when it were exposed to an average wind speed of 15.2km/h for 10 minutes and 28.5% when it were exposed to a 28.2km/h wind for 10 minutes. The colder heat source temperature were reduced by 26.2% when it were exposed to an average wind speed of 15.2km/h for 10 minutes and 35.3% when it were exposed to a 28.2km/h wind for 10 minutes. These values differ from the rule of thumb. From the experiment results it seems that wind of nearly 16km/h (10mph) do not reduce the hotspot temperature by 50% but by nearly 20% and a 28km/h (17.5mph) wind will reduce the hotspot temperature by nearly 30% and not 60% as thought

Table 2
Rule of thumb vs experiment results

	% Temperature loss		
Wind speed in km/h	**Rule of thumb**	**Hotter heat source**	**Colder heat source**
15.2	50	17.9	26.2
28.2	60	28.5	35.3

earlier depending on the hotspot temperature. The results are summarized in Table 2.

Due to a combination of various factors that influence the temperature readings as well as airflow around the heated object that were not considered during this study, the results of this study cannot be used to formulate a correction factor for wind but can only serves as an indication to the behavior of hotspots in windy conditions. By taking the above mentioned results into account next time you do a thermal survey in windy conditions, will add more credibility to your reported results.

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DEVELOPMENT OF A CLINICAL VASCULAR OPTICS MEASUREMENT FACILITY - THE NEWCASTLE UPON TYNE EXPERIENCE

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The microvascular diagnostics service based in Newcastle upon Tyne provides a comprehensive array of mainly optical and thermal technologies which are utilised to access micro- circulatory blood flow and function. These vascular optical techniques include thermal imaging, capillaroscopy, laser Doppler imaging and flowmetry, tissue spectroscopy and multi-site photoplethysmography. The test portfolio covers four main areas: Connective Tissue Disease and Raynaud's phenomenon assessments, Specialist Limb studies (i.e. amputation level, muscle compartment perfusion and venous physiology), Neurovascular Assessment and Burn Depth Assessment. The measurement service at Freeman is greatly benefiting from a new state- of-the-art purpose-built temperature and humidity-controlled room, enabling investigations to be performed efficiently and with confidence. The room's special air conditioning system can also be programmed to rapidly shift operating conditions between cold (e.g. 15 oC) and hot (30 oC) ambient temperatures for whole body thermal physiology assessments. Development project work is undertaken which includes microvascular endothelial function assessment, novel assessments in Chronic Fatigue Syndrome / ME, multi-site photoplethysmography, fluorescence spectroscopy in scleroderma, and thermoregulation in restless leg syndrome and Frey syndrome. The measurement facility forms a unique clinical measurement and research resource in the UK. The history and development of the facility, routine clinical services offered, and research work currently undertaken will each be summarized.

EVALUATION OF MICRO-CRACKS IN FACADES USING THERMOGRAPHY

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Infrared thermography is a non-destructive testing technology that can be applied in several areas of knowledge. Cameras collect infrared radiation emitted by the surface, covertly into electrical signals and create a thermal image showing the superficial temperature distribution.

Thermography has been applied to buildings for some decades and allows the detection of insulation defects, air leakage, heat loss through windows, dampness, "hidden details" (subsurface pipes, flues, ducts, and wall ties), examination of heating systems and preventive maintenance. The potential for this technology is high although its application to civil engineering has not been greatly studied.

The Building Physics Laboratory (LFC) of Engineering Faculty - Porto University (FEUP) has been carrying out research in this field over the last ten years. Several studies were carried out, namely:

"Sensibility analysis of parameters that affect measurements (emissivity, environmental conditions - temperature and relative humidity, colour and reflectivity);

"Studies concerning the wetting/drying process and capillary absorption of specimens;

"Studies about thermal comfort of floor coatings.

One important question is to know if thermography allows a quantitative approach or only a qualitative one. To answer this question we have been developing a research proposal with a project financed by FCT (PTDC/ECM/114189/2009) where one of the goals is to show if a quantitative analysis in thermography is a real possibility.

In this paper we present the results of wetting/drying processes of wall coating samples with micro-cracks carried out in laboratory with very closely controlled climatic conditions (inside climatic chamber). The same experiments were made "in situ" on different facades of micro-cracked buildings. It was clearly demonstrated the difficulty to control measurements in field conditions due to the wide range of parameters that may affect the termograms.

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INFRARED IMAGING OF THE CRANIO-CERVICAL-MANDIBULAR COMPLEX IN BRUXISM PATIENTS

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INTRODUCTIOn: Many authors have suggested the existence of a functional dependence between the cervical muscle and mastication muscles. In the sequence of this functional dependence postural, changes, especially in the head and neck, can influence certain neuronal-muscular patterns leading to the development temporomandibular disorders. The existing of hyperactivity of the mastication muscle in bruxism patients can originate areas of neuro muscular sensibility that can be detected by thermography with asymmetric thermogram patterns. It is therefore important to evaluate the existing differences of head and neck posture in bruxism patients and asymptomatic individuals and the respective correlation of the thermographic patterns.

METHODS: 32 individuals (16 bruxism patient and 16 asymptomatic individuals) ages between 22-26 years old, all students of the Dental Faculty of Porto University were selected for this experiment. A clinical examination was made in order to diagnose the presence of signs and symptoms of bruxism. The thermographic evaluation was made using the thermographic camera FLIR® A325.

RESULTS: The temperature differences obtained by thermography showed asymmetric patterns in the temporomandibular joint and within most of the muscles of the cranio- cervic-mandibular complex.

CONCLUSION: Infrared imaging technique can be a complement method of diagnostic in temporomandibular disorders, when evaluating the possible association of specific muscles of the cranio-cervico-mandibular complex with an increased muscular activity seen in bruxism patients.

ASSESING THE TEMPOROMANDIBULAR JOINT TEMPERATURE OF PROFESSIONAL SINGERS USING INFRARED THERMOGRAPHY

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Professional singers need technical, physical and physiological skills that determine their career regarding the performance productivity. Performing arts medicine studies the pathological consequences of a daily activity inherent to various artists, in this particular case we intend to introduce infrared thermography in the examination of the biomechanics of the temporomadibular joint (TMJ) during singing. It is important to study and have a precise screening of any eventual problems inherent to their daily activity with specific tasks, on maintaining different vocal registrations according to their pitch. The orofacial structures in this particular case should be of vital importance for professional singers, especially the TMJ.

In this research we studied the TMJs biomechanics in a group of Professional singers in order to diagnose temporomandibular disorders (TMDs) and/or condilar hypermobility, and compared the different existing thermogram patterns using the thermographic camera FLIR® A325. Lateral thermograms of the TMJ were obtained of the professional singers.

EVALUATION OF THE MASTICATORY MUSCLES TEMPERATURE BY THERMAL IMAGING DURING MASTICATION

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Mastication is a complex process involving many different movements, as well as automation of different intra and extra oral structures. In this context, the mastication not only involves jaw movements, but also other associated structures, such as head and neck, with a mandibular kinematic and/or alteration of bioelectrical potentials of the muscles involved in chewing. This study intended to compare the bioelectrical potentials during mastication, of the masticatory muscles when chewing a carrot, with the thermal imaging obtained of lateral orofacial thermograms with the thermographic camera FLIR® A325, before and after mastication. Ten young, healthy individuals, without temporomandibular disorders (confirmed by the Research Diagnosis Criteria) and with full dentition, were included in this research.