



Thermography



| | Wavelength in meters | | Imaging modality | Medical information |
|--|----------------------------|--|------------------|---|
| <div style="display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-weight: bold; font-size: 24px;">Low Energy</div> <div style="writing-mode: vertical-rl; transform: rotate(180deg); font-weight: bold; font-size: 24px;">High Energy</div> </div> | Radio Wave 10^3 | | MRI image | <i>Anatomy</i> Edema, flow Chemical composition |
| | Microwave 10^{-2} | | Ultrasound | <i>Anatomy</i> Tissue structure characteristics, flow |
| | Infrared 10^{-5} | | Infrared Imaging | <i>Anatomy and Physiology</i> Surface temperature |
| | Visible Light 10^{-6} | | Arthroscopy | <i>Anatomy</i> Intraarticular structure, inflammation |
| | Ultraviolet 10^{-8} | | UV-radiation | <i>Healing/Therapy</i> Skin, chronic Inflammation |
| | X-Ray 10^{-10} | | X-Ray | <i>Anatomy</i> Bone injuries |
| | Gamma ray 10^{-12} | | Scintigraphy | <i>Physiology</i> Inflammation, metabolism of the bone |

Unit -5 APPLICATIONS OF ULTRASONIC AND THERMOGRAPHY



What is Infrared Thermography?

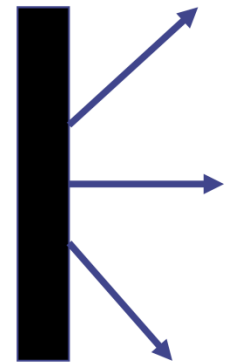


- Infrared- below last visible color (red)
- Therm- Greek word for heat
- Graph- writing or representation for a specified process
- *Basically a graphical representation of heat*



Emittance

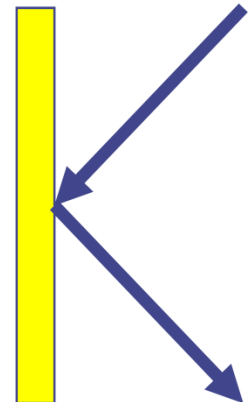
- A perfect emitter is referred to as a Black body and $E = 1$.
- All bodies in nature are colored bodies and have an $E < 1$.
- Human skin is .98
- A good emitter is a good absorber of energy.





Reflectance

- The amount of light reflected from an object.
- Aluminum tape $R=.98$ $E=.02$
- A first surface mirror is a good reflector.

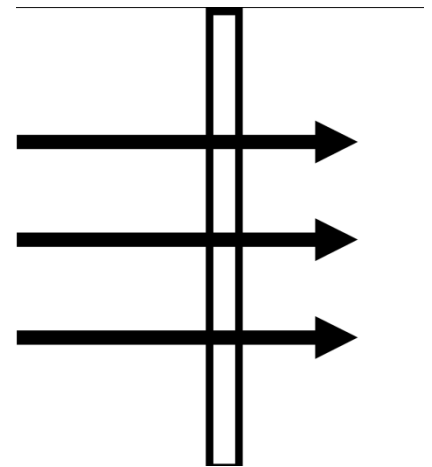




Transmittance



- The heat transmitted through an object to the camera.
- Thin plastics are transmissive.
- Opaque objects will not transmit energy.
(Ex. metals, woods, concrete)





Heat



- Heat may be defined as a form of energy created by the molecular motions of an object.
- temperature is a measure of the total kinetic energy of all the molecules in the objects.



Temperature

- Temperature is a measure of the thermal energy contained by an object; the degree of hotness or coldness of an object

(e.g. atmosphere, living body) measurable by any of a number of relative scales.

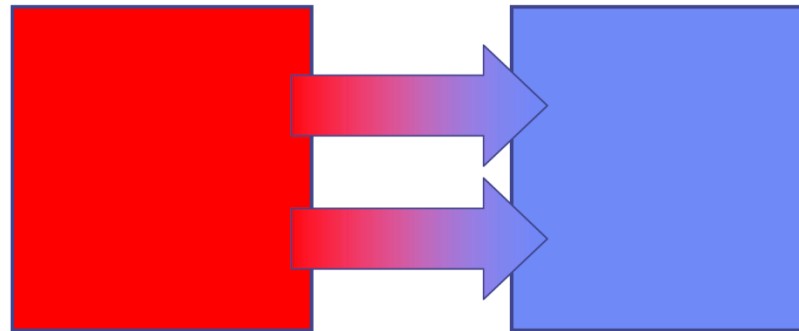
- A measure of the quantity of heat present in something.



Heat Transfer

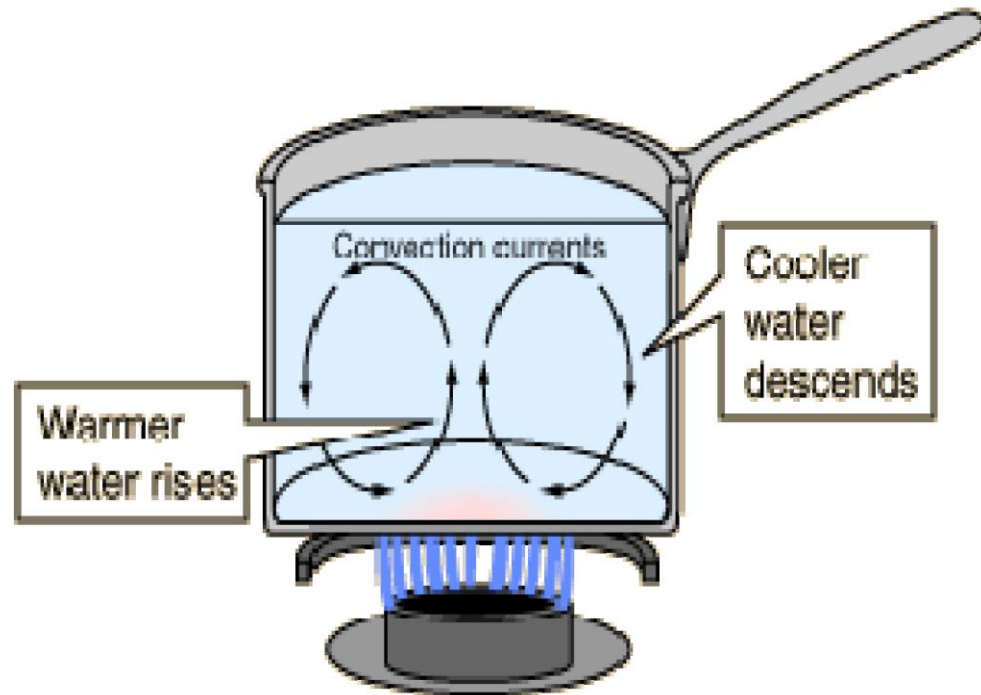


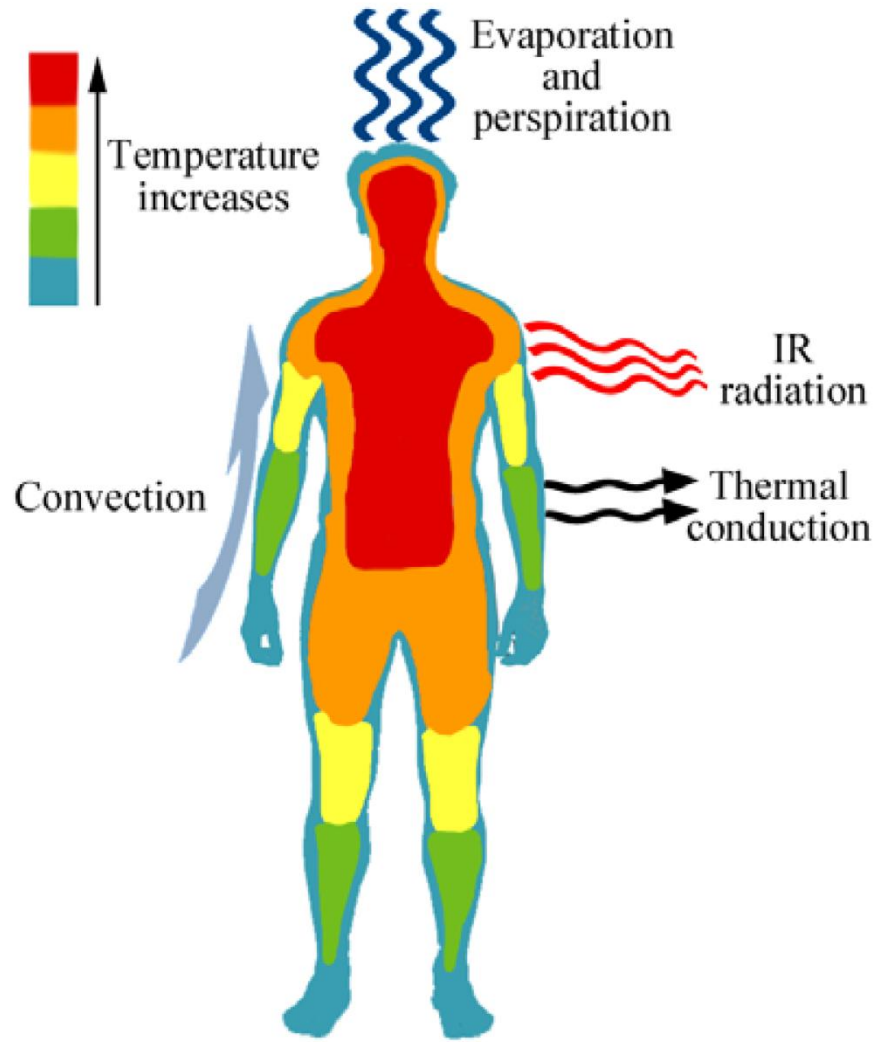
- Heat energy will transfer from an object of high temperature to an object or region of lower temperature unless it is blocked.

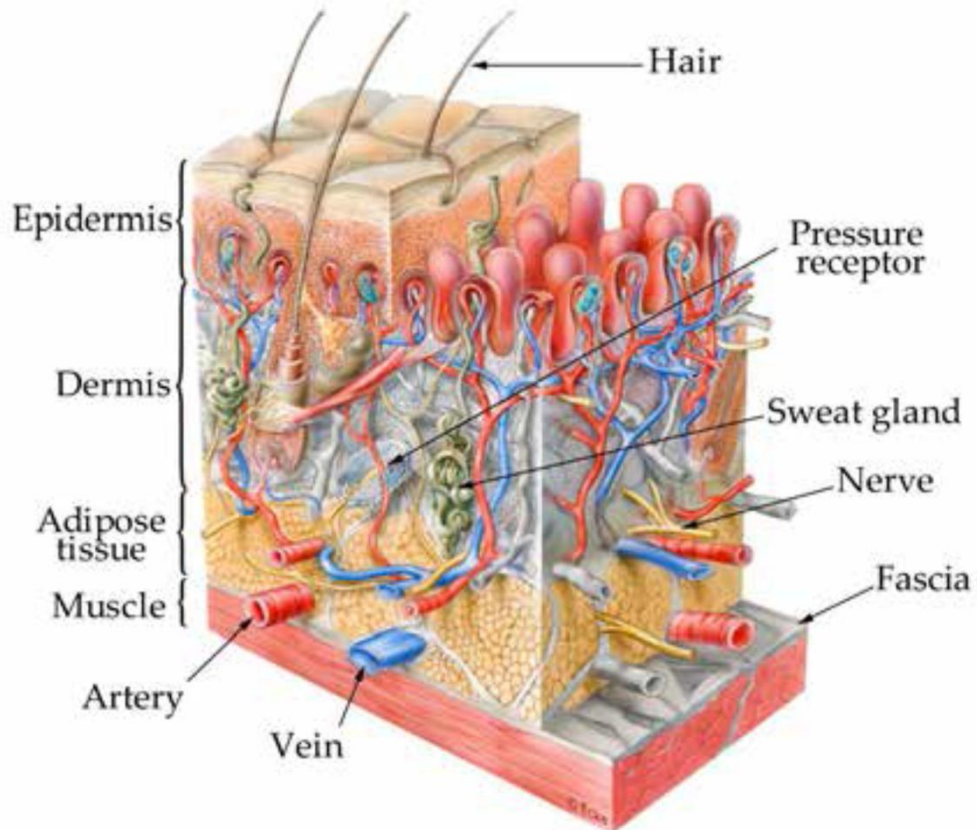




Modes of Heat Transfer











1. Pick up camera with right or left hand.
2. Press **PWR/NO** button (Figure 2.1). Screen display will resemble Figure 2.2.



Figure 2.1



Figure 2.2

3. Remove **Lens Cap** (Figure 2.3- lens cap on, Figure 2.4 - lens cap removed).



Figure 2.3



Figure 2.4

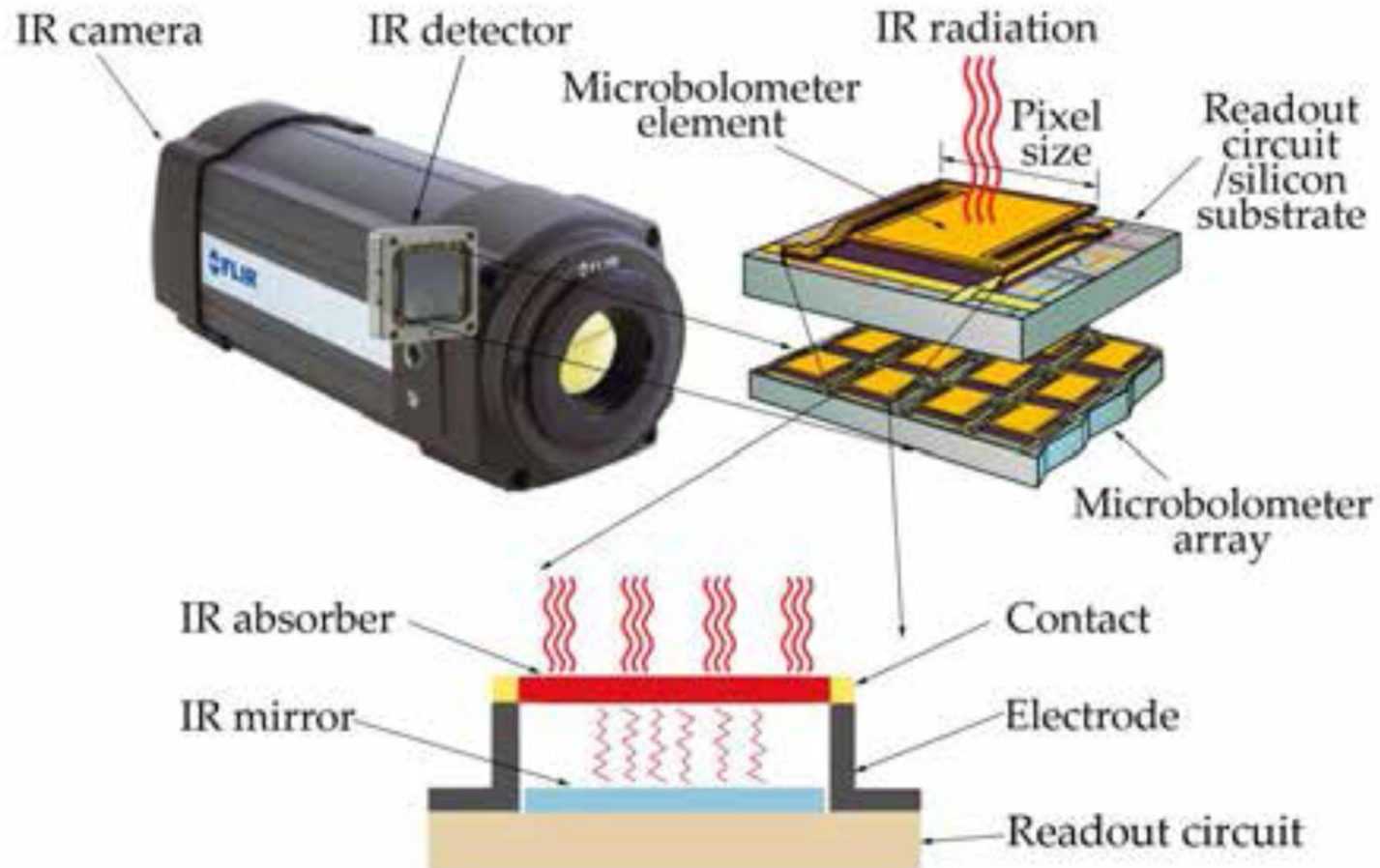
4. Press **PWR/NO** button (Figure 2.5) and hold > 2 seconds to **power off**. Screen will display “Shutting down in 2 seconds, 1 second, powering down” (Figure 2.6).



Figure 2.5

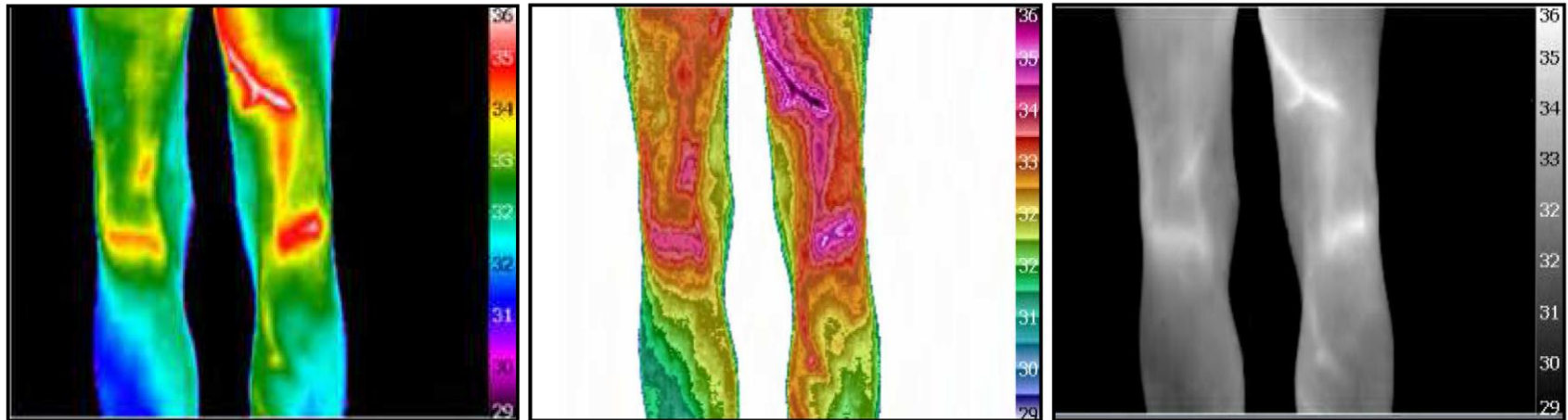


Figure 2.6





human skin temperature profile



a. "rainbow"

b. "rainbow strong-contrast"

c. "gray color"



Image fusion



a. digital image



b. merged image



c. infrared image



Thermography

- non-invasive
- non-contact tool
- no radiation
- 10° C - 55° C to an accuracy of 0.1° C
- the IR camera and a standard PC



Medical applications



- Rheumatology
- Neurology
- Oncology
- Physiotherapy
- sports medicine



Medical applications



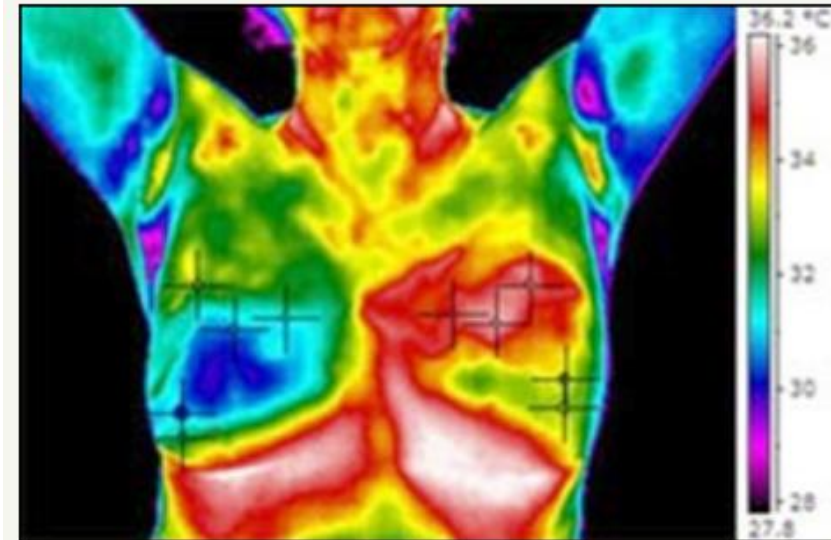
- Breast pathologies
- Extra-Cranial Vessel Disease
- Neuro-Musculo-Skeletal
- Vertebrae (nerve problems/arthritis)
- Lower Extremity Vessel Disease



BREASTS PATHOLOGIES



- breast cancer
- benign tumour
- Mastitis
- fibrocystic breast disease





BREASTS PATHOLOGIES



- cancers create heat which can be imaged by digital infrared imaging
- These differences in temperature are referred to as a Delta T.
- **angiogenesis** of the tumour
- Cancerous tumours produce a chemical
- vaso-dilation



sport-specific case studies of injuries

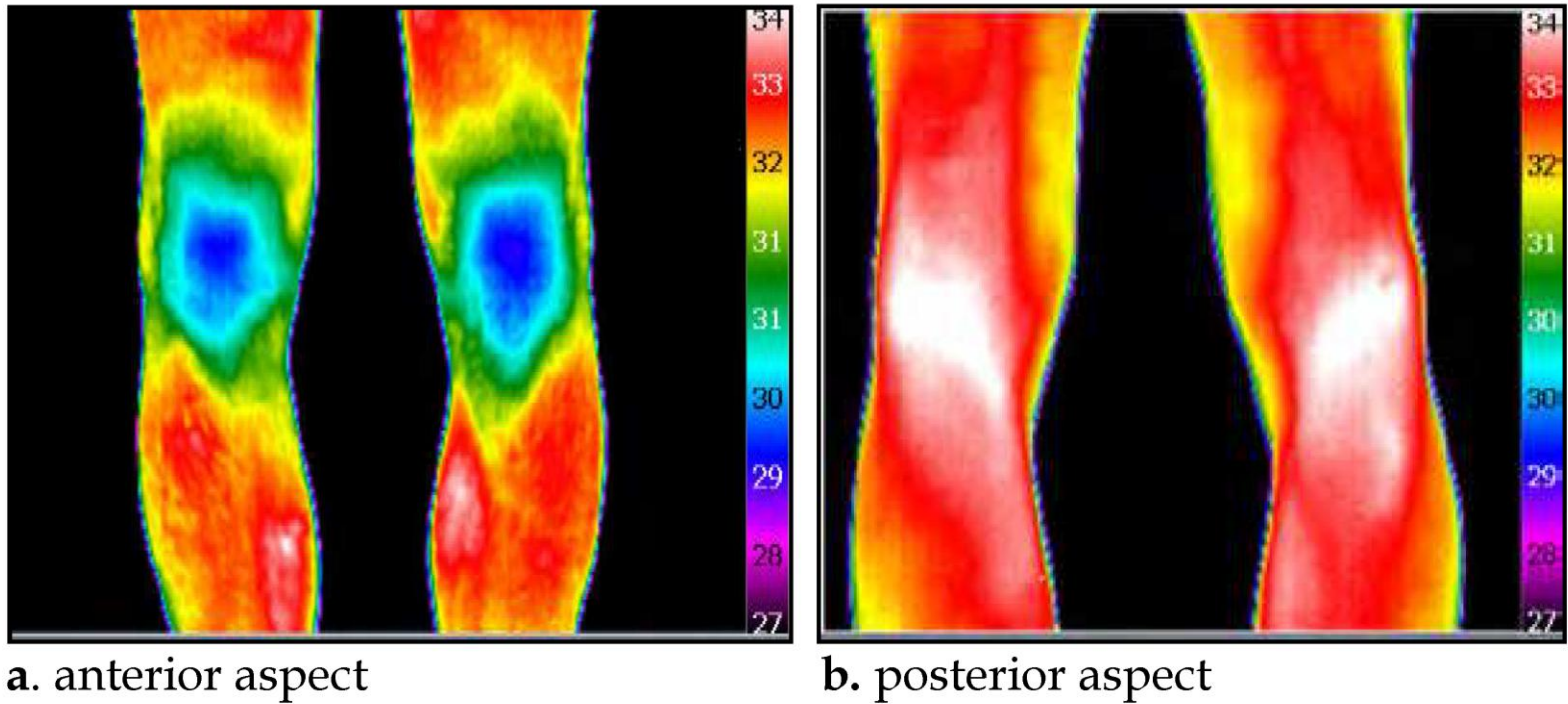


Fig. 5. Infrared image of healthy knee



Overuse injuries



- Football players

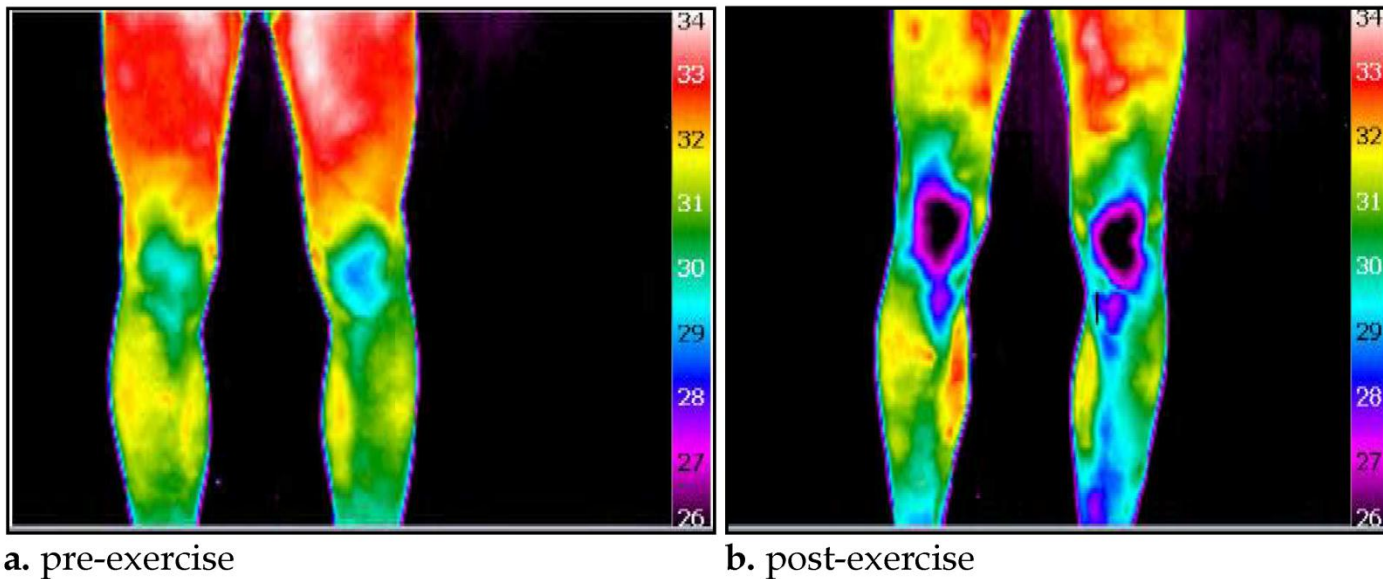
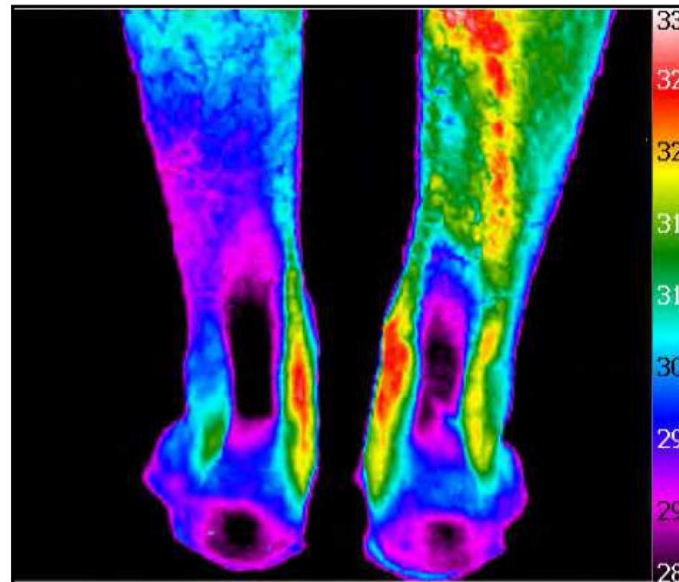


Fig. 6. Infrared image of the anterior aspect of the knee



- morning stiffness on the musculotendinosus junction on his left leg

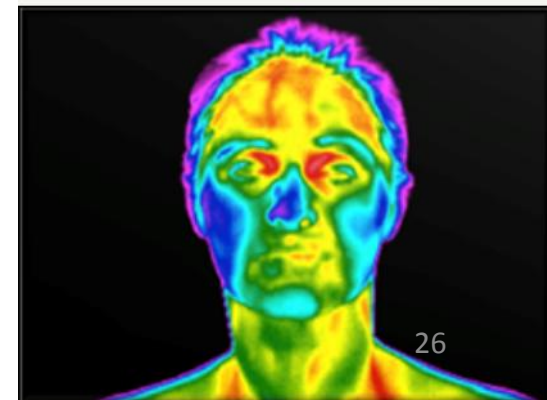




EXTRA-CRANIAL VESSEL DISEASE



- blood vessels in the face and skull
- clues to the potential of developing vascular disease which might lead to stroke
- various types of headache (migraine, cluster, cervical spine related)
- dental decay and cavitations without routine screening x-rays





NEURO-MUSCULO-SKELETAL



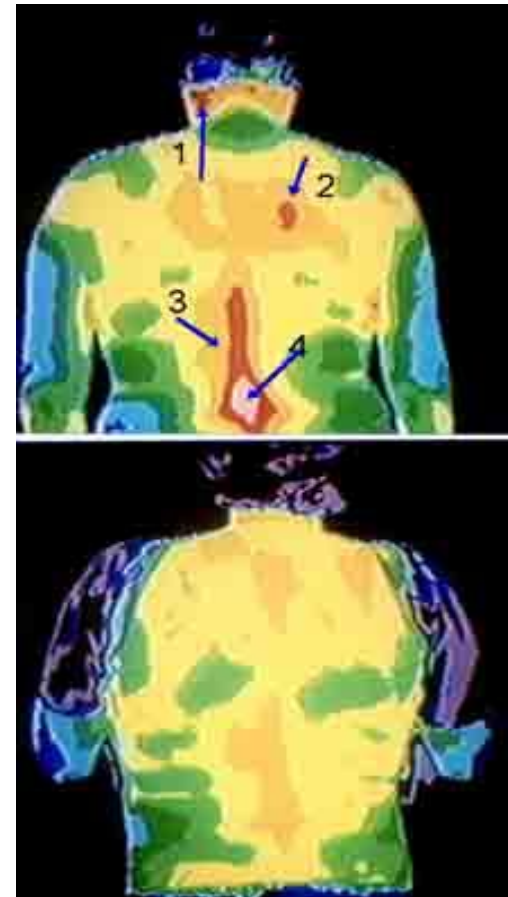
- When muscle tissue is strained or torn, it releases chemicals which cause increased heat
- Hyperthermia
- Fibromyalgia
- legs and soles of the feet
- source of probable spinal injuries



Fibromyalgia



- spray and stretch techniques
- specific chiropractic manipulation
- deep tissue massage





LOWER EXTREMITY VESSEL DISEASE



- deep vein thrombosis
- diabetic neuropathies of the feet, before the foot becomes insensate



MEDICAL THERMOGRAPHY



- **RESPIRATORY DYSFUNCTIONS**

- at airports and is useful for monitoring asthma, allergies, bronchitis, influenza etc

DIGESTIVE DISORDERS

diagnosis of urgent gastrointestinal pathology, especially appendicitis, irritable bowel syndrome (IBS), colitis, ulcerative colitis and hyper and hypo gastric secretions



- **URINARY DISEASES**

- Urinary tract infections, kidney pathology etc

CARDIOVASCULAR AND CIRCULATORY DISORDERS

preventing heart disease and serious circulatory problems



- **LYMPHATIC DYSFUNCTIONS**
 - therapy effectiveness in severe cases of lymphoma, leukaemia

SURGICAL ASSISTANCE

SKIN PROBLEMS

EAR, NOSE, AND THROAT DYSFUNCTION