

# Infrared imaging of venipuncture sites, an evaluation of effectiveness on vein visualization

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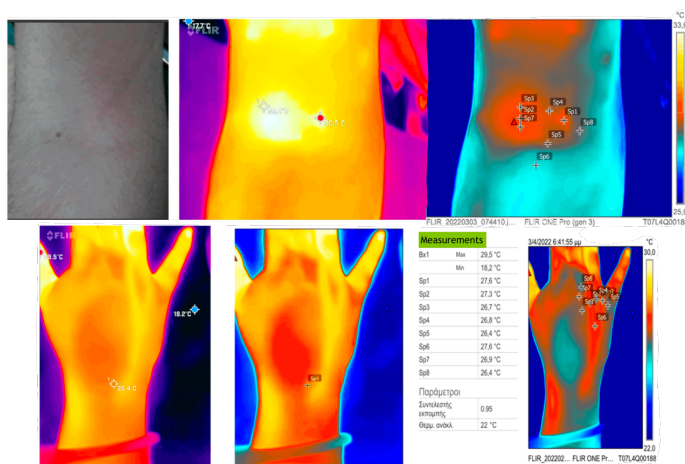


Image 1: Thermograms of the cubital area and the hand

**Materials & Methods:** 12 thermograms of the cubital area and 2 thermograms of the hand of 14 patients were taken with the FLIR ONE Pro Thermal Imaging Camera for Android. The thermograms are obtained with tourniquet application above the potential venipuncture site. The patient remained with their arms outstretched and without any cloth covering the site for about five minutes. All thermograms were processed in the FLIR TOOLS application. The color pallet was changed in order to obtain better contrast. The temperature range was adjusted according to each thermogram, and an equal distribution of spots were selected inside and outside the veins. The areas of interest were palpated to determine the location of the veins. The temperature deviation index was calculated based on the formula  $T_{index} = (T_{in} - T_{out}) / T_{out}$ .

**Results :** According to our results, there is no overlap in the temperatures inside and outside the veins. There is no significant difference in temperature regardless of the frequency of blood tests or other factors that affect the blood vessels.

An interesting case is presented in the third thermogram which corresponds to a person with hypothyroidism. A greater temperature deviation was observed in the women's thermograms as compared to those of men, probably indicating a dependence on the phase of the menstrual cycle.

A/A	Gender	$T_{in} \pm SD_{in}$	$T_{out} \pm SD_{out}$	$T_{index, \%}$
1	F	30,15 $\pm$ 0,32	28,95 $\pm$ 0,58	4,15
2	M	30,13 $\pm$ 0,1	28,87 $\pm$ 0,64	4,36
3	F	23,4 $\pm$ 0,24	22,9 $\pm$ 0,39	2,18
4	M	30,35 $\pm$ 0,06	29,3 $\pm$ 0,55	3,58
5	M	31,48 $\pm$ 0,13	30,18 $\pm$ 0,33	4,31
6	F	31,37 $\pm$ 0,24	30,2 $\pm$ 0,3	3,86
7	F	30,95 $\pm$ 0,27	29,98 $\pm$ 0,3	3,25
8	F	30,7 $\pm$ 0,27	29,6 $\pm$ 0,26	3,72
9	F	31,9 $\pm$ 0	30,7 $\pm$ 0,46	3,91
10	M	29,47 $\pm$ 0,15	28,27 $\pm$ 0,45	4,25
11	M hand	28,03 $\pm$ 0,21	26,93 $\pm$ 0,55	4,08
12	F hand	27,35 $\pm$ 0,33	26,58 $\pm$ 0,21	2,92
13	F	31 $\pm$ 0,1	29,57 $\pm$ 0,6	4,85
14	F	31,3 $\pm$ 0,17	30,13 $\pm$ 0,75	3,87

Table with the mean values of temperatures of each thermogram

**Introduction/Purpose:** Infrared radiation (IR) is emitted by all objects at temperature above absolute zero and the amount of radiation increases with temperature of the object. Thermography is a type of infrared imaging in which a thermographic camera can convert the invisible radiation into a visual image providing a temperature distribution map of an object's surface without any contact with it. Venipuncture is a necessary procedure for obtaining intravenous access for collecting blood samples for clinical testing, for blood donation and for intravenous therapy. Certain groups of people might have difficult veins to access, such as patients with chronic disease or patients with fear of blood or needles. In order to reduce the patient's stress and pain, this study aims to record the use of thermography to obtain a real-time image of the venous system of the venipuncture sites of the cubital area and the hand and to help choose the right vein in order to obtain the blood sample at the first attempt with as less pain as possible for the patient.

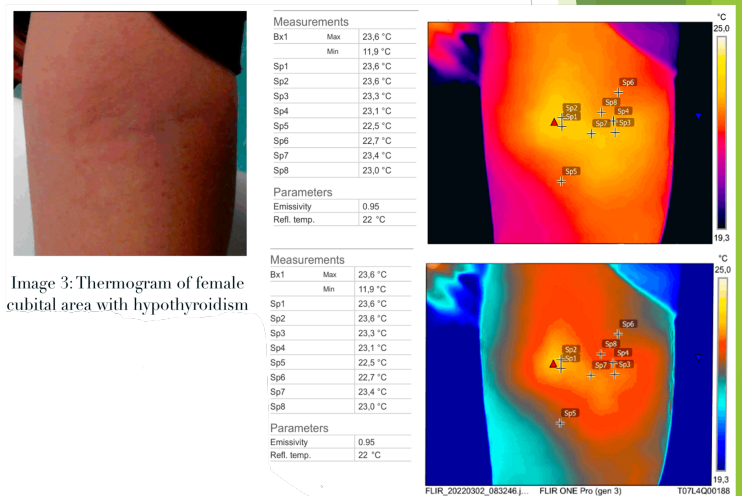


Image 3: Thermogram of female cubital area with hypothyroidism

**Conclusion:** Using a thermal camera, we obtained information about the location of the higher perfused vein even if it was not visible with naked eyes. The observed variations in temperature seem to depend on hormonal factors. The thermal camera appears as a promising tool for better vein visualisation. On going work with image processing methods is in progress aiming at optimisation of vein visualisation, especially in patients with chronic illnesses.