# In vitro pilot study of temperature field dynamics with cryoimpact

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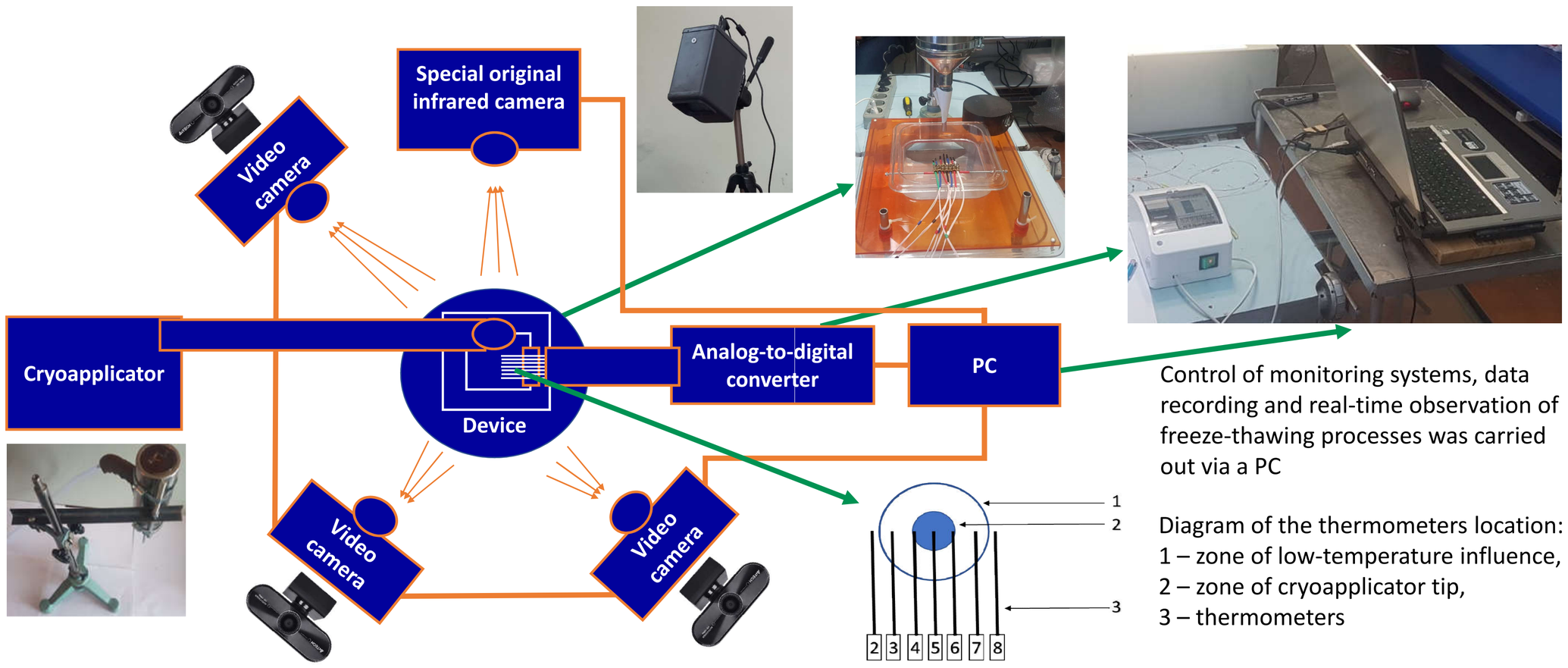
Cryosurgery sets the goal of guaranteed destruction of pathological tissue with maximum preservation of adjacent healthy tissues. The clinical use of generally accepted methods of visualization of the freeze-thawing does not fully answer the question of whether the cryodestruction zone was sufficiently formed. Therefore, when planning a surgery, especially in oncodermatology, it is extremely important to predict the movement of the freezing front as well as dynamics of the temperature field inside and outside the frozen zone for various modes of cryoimpact and features of the impact objects.

In order to predict the freezing zone during cryodestruction of biological tissues in vivo, a pilot study of the thermal field dynamics during local contact cryoimpact in a model system in vitro has been performed.



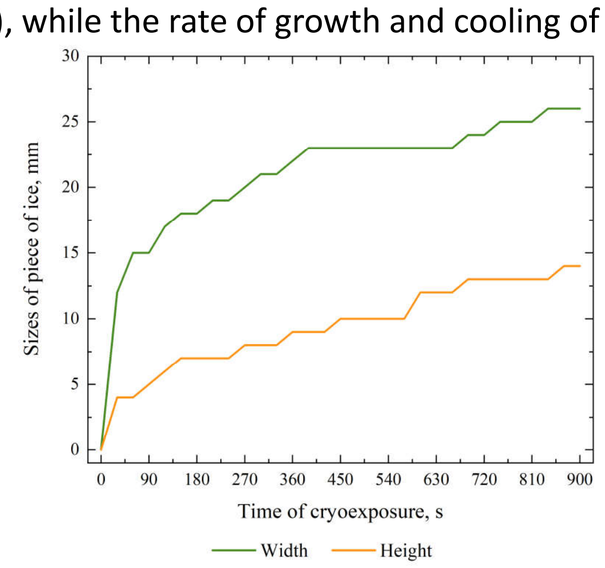

Control of monitoring systems, data recording and real-time observation of freeze-thawing processes was carried out via a PC

Diagram of the thermometers location:
1 – zone of low-temperature influence,
2 – zone of cryoapplicator tip,
3 – thermometers

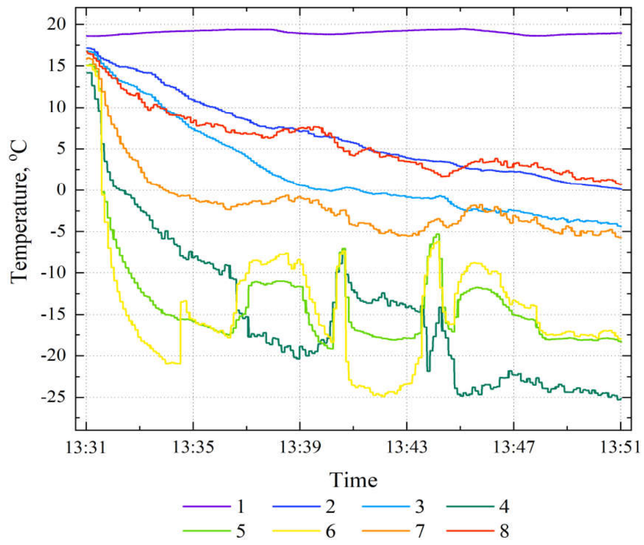
The temperature dynamics in the zone of low-temperature impact was studied in a model system with a gel of 5% gelatin solution. The results of a thermal imaging study of the dynamics of ice spot surface growth in the freezing zone and temperature distribution in it coincided with the ones of direct thermometry (according to the data of thermometers at the corresponding points) and the corresponding sizes of the ice zone (according to the analysis of video recordings from cameras). Immediately after touching the applicator to the gel surface, the formation of an ice zone was observed, the diameter of which on the gel surface was nearly one and a half times greater than the depth of freezing. At this initial stage, the highest rate of cooling and ice growth was also observed.

During further growth (about 1.5 min of cooling later), the ice lump reached a hemispherical shape, which remained so during the cryoexposure (15 min), while the rate of growth and cooling of the ice gradually slowed down.

A typical graph showing the increase in ice piece sizes

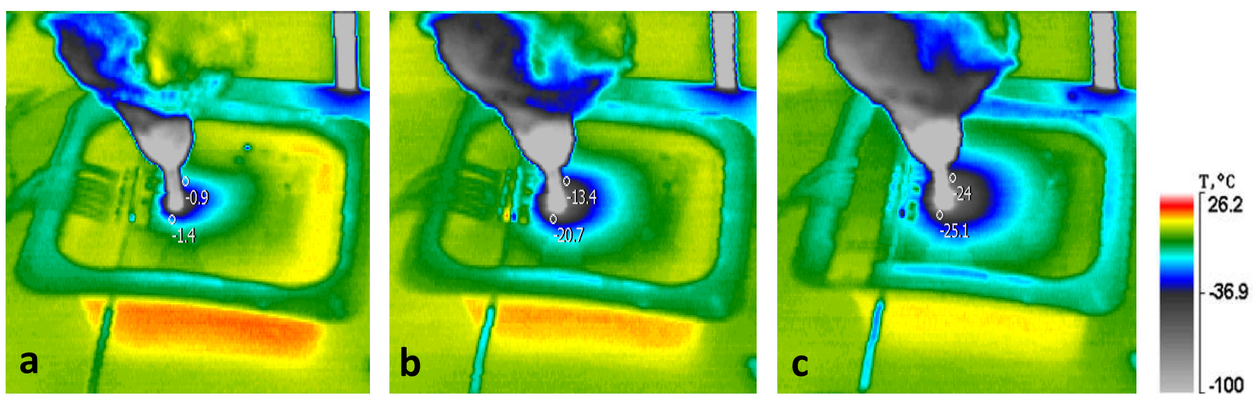



Temperature dynamics by direct thermometry




Thermometer 1 measured the temperature in the room

Thermograms of the gel surface: a – in the first seconds of cryoimpact; b – after 2.5 minutes from the start of cryoimpact; c – 11 minutes after the start of cryoimpact




Further research involves the use of various cryoinstruments and freeze-thawing modes, varying the composition and temperature of the model system, simulating the presence of blood vessels in the zone of cryoimpact, etc.

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