Knee temperatures measured in vivo after arthroscopic ACL reconstruction followed by cryotherapy with gel-packs or computer controlled heat extraction

**Supplementary material**
Measuring device with 4 skin sensors (#3-SK to #6-SK), one bandage sensor (#7-BA) and 2 connectors for deep tissue catheter sensors (#1-ICN, #2-SC). Data are recorded continually and transferred after measurements to a portable computer. The measuring device and sensors are cleaned and prepared for next measurements.
Calibration of temperature probes

Temperature of 5 probes as measured in sequence on the same channel of the measurement device (channel 1). No thermistor calibration is applied: $\text{Err}=\pm 0.05^\circ\text{C}$.

Temperature of the same probes as in the left figure after calibration: $\text{Err}=\pm 0.0033^\circ\text{C}$.

Test setup: calibration of temperature probes.
Measuring specific heat capacity ($c_p$) of gel

**RESULTS**

<table>
<thead>
<tr>
<th>Temperature</th>
<th>$c_p$ (GEL)</th>
<th>$c_p$ (WATER, ICE)</th>
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<tbody>
<tr>
<td>+12 °C</td>
<td>4.6 kJ/(kg K)</td>
<td>4.19 kJ/(kg K)</td>
</tr>
<tr>
<td>-5 °C</td>
<td>4.4 kJ/(kg K)</td>
<td>2.07 kJ/(kg K)</td>
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GEL has no phase change from -6 °C to +15 °C.

Test setup on the table for measuring specific heat capacity by comparing temperature of the same amount (300 g) of water and gel during 18 hours of warming.

Test setup in constant temperature chamber (cellar). Styropore boxes are hanged on metal grid placed below the ceiling. The measuring method is the same as in the experiment from the left figure.
Cooling with gel-pack and cPad

Detailed figure of gel-pack (left) and Waegener pad (cPad) (right).
Volunteer – cooling with gel-pack

View on the right knee, (left) probes on the skin, (middle) covered by compressive bandage and a probe on it, (right) all covered by gel-pack in a blanket sac.

Gel-pack with dimensions 370 x 290 cm and weight 1.5 kg was used. Initial temperature was -3 °C. The gel-pack was put in a blanked sac and placed over the frontal part of the knee. The knee is covered by the gel-pack just for 2/3 of the frontal area.
Implanted sensors (#1-ICN, #2-SC) (left) and skin sensors (#3-SK12, #6-SK9) (right) near the end of surgery.
Groups of P01 – P08: cooling with gel-pack
Groups of P09 – P20: cooling with cPad