Effect of Arthroscopy and Continuous Cryotherapy on the Intra-articular Temperature of the Knee

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Purpose: The purpose of this study was to determine "in vivo" the intra-articular temperature of the knee in baseline situation, to quantify its variation during the arthroscopic surgery and the repercussion on the body temperature, and to quantify the variation of the intra-articular temperature after the application of topic cold postoperatively. **Type of Study:** Case series. Experimental study in patients who undergo arthroscopic surgery of the knee monitoring their intra-articular temperature. **Methods:** An intra-articular temperature data acquisition system is used in 30 patients who undergo arthroscopic surgery of the knee using saline solution at room temperature and monitoring their body temperature with a rectal temperature probe. In 23 of these patients, after surgery, a plastic bag with 2 kg of ice is applied on the knee, and the variation of the intra-articular temperature is measured for at least 1 hour. **Results:** The basal temperature of the knee (32.22° ± 0.28°C) decreases during the intervention using saline fluid at room temperature to nearly equalize it (24.49° ± 0.97°C), and it led to a drop of the body temperature of 0.14° ± 0.04°C. The continuous external application of ice after the arthroscopy produces a drop of the intra-articular temperature directly related to the time, with a magnitude of almost 4°C in the first hour. **Conclusions:** The intra-articular baseline temperature of the knee is significantly lower than that of the body, and the repercussion of its drop during arthroscopic surgery on the body temperature is insignificant. The external application of ice is an effective and sure method to diminish the intra-articular temperature of the knee. **Level of Evidence:** Level IV, case series with no control group. **Key Words:** Knee—Arthroscopy—Intra-articular temperature—Cryotherapy.

The arthroscopic technology that has come into widespread use in the last 25 years requires continuous irrigation with a fluid that is usually colder than the interior of the joint, a point that has been a cause of concern to the surgeon because of the possible effect on intra-articular tissues as well as on the patient's body temperature. On the other hand, cryotherapy is widely used to reduce inflammation because of both pathological conditions[1] and postoperative reaction.[2-4] The development of new temperature measurement systems that allow us to carry out more exact and constant valuations, together with the digital treatment of data, enabled us to measure the intra-articular temperature of the knee in a baseline situation as well as its variations during arthroscopic surgery and the subsequent local application of cold liquid.

MATERIAL AND METHODS

To perform this study, we designed a system to measure the intra-articular temperature of the knee in different conditions in a group of patients who underwent arthroscopic surgery. The temperature data acquisition system is made up of a 12 × 1.6 mm PT 100 sensor of temperature (Intersa, Madrid, Spain) together with a conditioning sign and communications

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0749-8063/05/2105-3800$30.00/0

doi:10.1016/j.arthro.2005.01.011

Table 1. *Frequency of Interventions*

Meniscectomy	22
Extraction of loose body	2
Osteoarthritis	2
Lateral retinacular release	2
Diagnostic arthroscopy	2

module (National Instruments, Austin, TX) as well as data acquisition and monitoring program specifically designed for the study (Adaba Ingeniería, Madrid, Spain) that is run in a portable computer. The system measurement range is 0° to 100°C, with an accuracy of 0.1°C.

The study was performed in 30 patients, 19 men and 11 women, with an average age of 46.9 years and a range from 18 to 72 years, who underwent arthroscopic surgery on the knee. None of the patients presented with any associated systemic pathology, and they all gave their permission to be included in the study. We have exclusively selected interventions in which bleeding was absent or minimal (Table 1). In lateral retinacular release surgery, the measurement of temperature stops exactly before the surgeon proceeds to release the retinaculum to prevent the bleeding from influencing the measured values. This group of patients was not included in the later study.

Study 1

This study was designed to determine the intra-articular baseline temperature of the knee "in vivo," to quantify the variation of temperature in the knee that takes place during the arthroscopic intervention, and to verify whether a variation of the body temperature is produced as a consequence. In this study, all 30 patients were included. Interventions were performed under local or intradural anesthesia without using a tourniquet to avoid its possible influence on the knee temperature readings. All the measurements during the interventions were performed in the same operating room at room temperature. The average room temperature during all 30 interventions was 23.7° ± 0.21°C, and the average relative humidity was 49% ± 1.59%.

To perform the first study, the temperature sensor, previously sterilized by gas, was introduced into the joint inside an arthroscopic cannula through a suprapatellar external portal. Its situation at the bottom of the suprapatellar pouch was verified with the optical system, free in the joint fluid, with its end sticking out in the center of the cannula preventing contact with the synovial membrane that may modify the collected data (Fig 1). Before proceeding to the irrigation of the joint, the temperature of the knee was registered, and this was taken as the baseline temperature of the knee. Once the irrigation of the joint with saline solution at room temperature had begun and throughout surgery, a measurement of the intra-articular temperature of the knee with intervals of 30 seconds was performed. The data were stored in the computer as a continuous graph.

Throughout the surgical procedure the body temperature of the patient was continuously monitored, by means of a rectal temperature probe, with an accuracy of 0.1°C. The value of the body temperature was registered at intervals of 10 minutes. After the end of the arthroscopy, the temperature recording was stopped. The probe remained introduced in the knee of the patient inside the cannula and was protected with a compressing bandage to carry out the following study.

Study 2

The second part of this study, performed in 23 of the patients, began when the patient returned to his/her room, and a bag containing 2 kg of ice was applied directly on the skin, protected with a round of cotton bandage. The variation of the intra-articular temperature that takes place was measured and recorded at 30-second intervals for at least 1 hour.

Statistical Analysis of Data

The results obtained were compared by a Student paired *t* test, using the *t* correction of Student in the

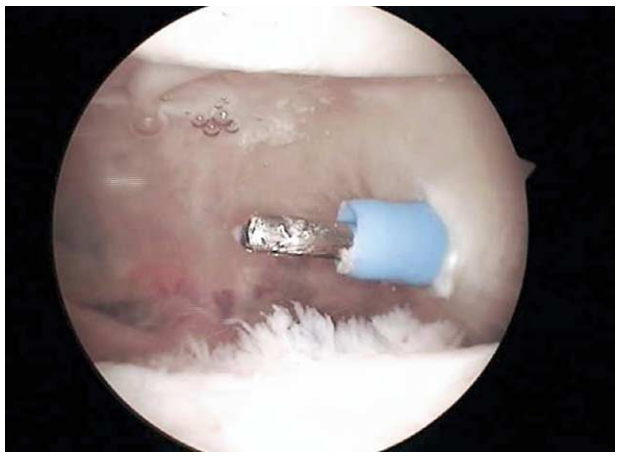

Figure 1. The temperature sensor is introduced into the joint inside an arthroscopic cannula at the bottom of the suprapatellar pouch preventing contact with the synovial membrane.