



## A simple solution to prevent the abdominal migration of temperature loggers, and to facilitate their smooth retrieval post-study in macaques

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### Introduction

Before being infected with an Influenza virus, 12 cynomolgus monkeys (*Macaca fascicularis*) were implanted with temperature data loggers. These devices are small implantable recorders that measure temperature with a high degree of accuracy, and store the data in their internal memory. All measurements are in real time, and can be accessed after the logger has been retrieved at the end of the study. After retrieval of the data, the logger can be re-programmed and re-used for as long as the battery lasts. The transmitters' upper surface is very smooth, and has no ridge or other affixing possibility to attach the logger to the abdominal wall. In previous experiments, we experienced that such loggers migrated through the entire abdomen (Fig. 1), which made surgery to retrieve the loggers difficult, necessitating almost an explorative laparotomy. In order to refine this retrieval surgery, a simple home-made solution was devised: A bled knot of non-resorbable suture material with needle was created around the logger, and the needle was used to attach the logger to the abdominal wall during wound closure.

Five months after insertion, the temperature loggers were removed from all 12 animals. All loggers were still fixed in the position where they had initially been stitched. The retrieval surgery was scored as a minor discomfort. All measured data was uploaded successfully into a PC. The implanted loggers did not have an adverse affect on the animal's health, which was checked daily. After retrieval, all animals were alive. The bled knot of non-resorbable suture material with needle around the logger showed to be a simple solution to prevent the abdominal migration of temperature loggers, and to facilitate their smooth retrieval post-study in macaques.



Fig. 1. Abdominal X-ray, lateral view: a non-attached logger that had migrated to the vertebral column is clearly visible. It is conceivable that surgery to retrieve the logger would be difficult, almost necessitating an explorative laparotomy.

### Materials & Methods

#### Animals, housing, and care

This study included 12 adult healthy male cynomolgus monkeys (*Macaca fascicularis*) that were housed at the Biomedical Primate Research Centre (BPRC, Rijswijk, the Netherlands), aged 6-13 years, and weighing 5.6-11.3 kg. All macaques were pair-housed (same-sex couples) in the experimental facility. The monkeys had no history of abdominal surgery. The procedures performed in this study were in agreement with the regulations for animal handling as described in the EU Directive 63/2010, and in accordance with the Weatherall report (2006). During the study, the monkeys were kept under close veterinary supervision. The animals were fed with commercial monkey pellets (Sniff, Soest, Germany) supplemented with fruit and vegetables, and drinking water was available ad libitum. Food was removed 16 hours prior to sedation but water intake was never restricted. During the course of the study, animals were checked at least twice daily for appetite, general behaviour, stool consistency, and local side-effects of the surgery.

### Surgery

Anesthesia was achieved by means of 10 mg/kg ketamine (Ketamine 10%; Alfasan Nederland BV, Woerden, NL, 100 mg/ml) and medetomidine IM (Sedastart; AST Farma B.V., Oudewater, NL, 1 mg/ml). As analgesia, 1 h prior to surgery, 0.20 mg/kg meloxicam (Metacam®, Boehringer Ingelheim, Alkmaar, The Netherlands) was administered together with 0.02 mg/kg buprenorphine (Buprecare®, AST Farma B.V., Oudewater, The Netherlands). After surgery, animals received meloxicam (0.10 mg/kg PO) once daily for two days. Subsequently, the abdomen was shaved and prepared with chlorhexidine and povidone-iodine. The macaques were placed on a heated blanket in order to stabilise body temperature, and were breathing room air spontaneously throughout the surgery.

After pre-operative preparation, a 3cm skin incision (below the umbilicus) was made along the midline. Subsequently, the skin was separated from the abdominal muscles. The abdomen was opened, the sterile transmitter with a bled knot of non-resorbable suture material (FS 26, 18" ~ 45cm, size 2-0) around it (Fig. 2), was inserted into the abdominal cavity, and the needle was used to attach the logger to the abdominal wall during linea alba wound closure (Fig. 3). The abdomen was closed with a continuing suture 2-0, and the skin incision was closed with single-knot sutures 2.0. The position of the logger is shown in Fig. 4.

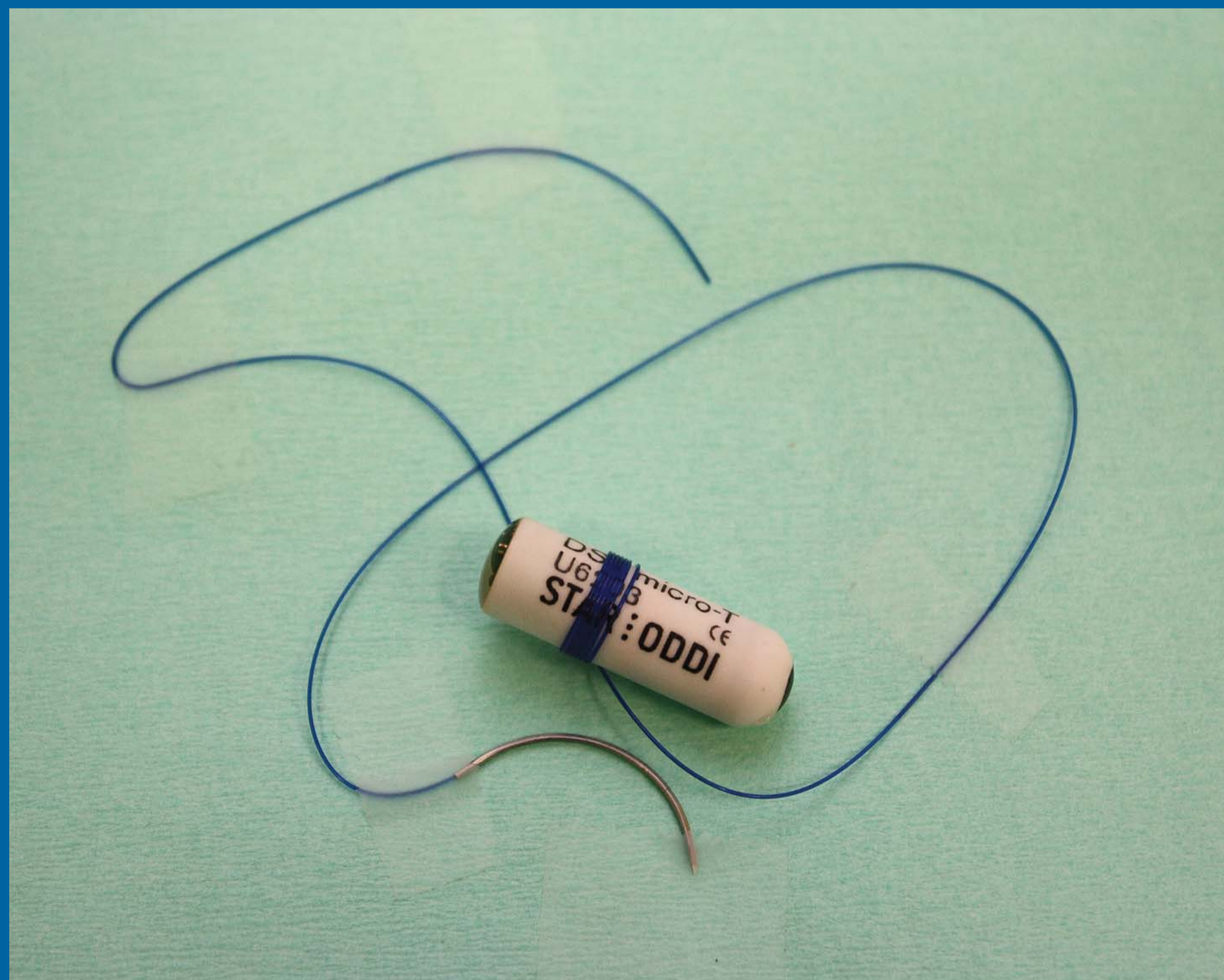


Fig. 2. The pre-operative prepared logger, with suture material and bled knot around it.

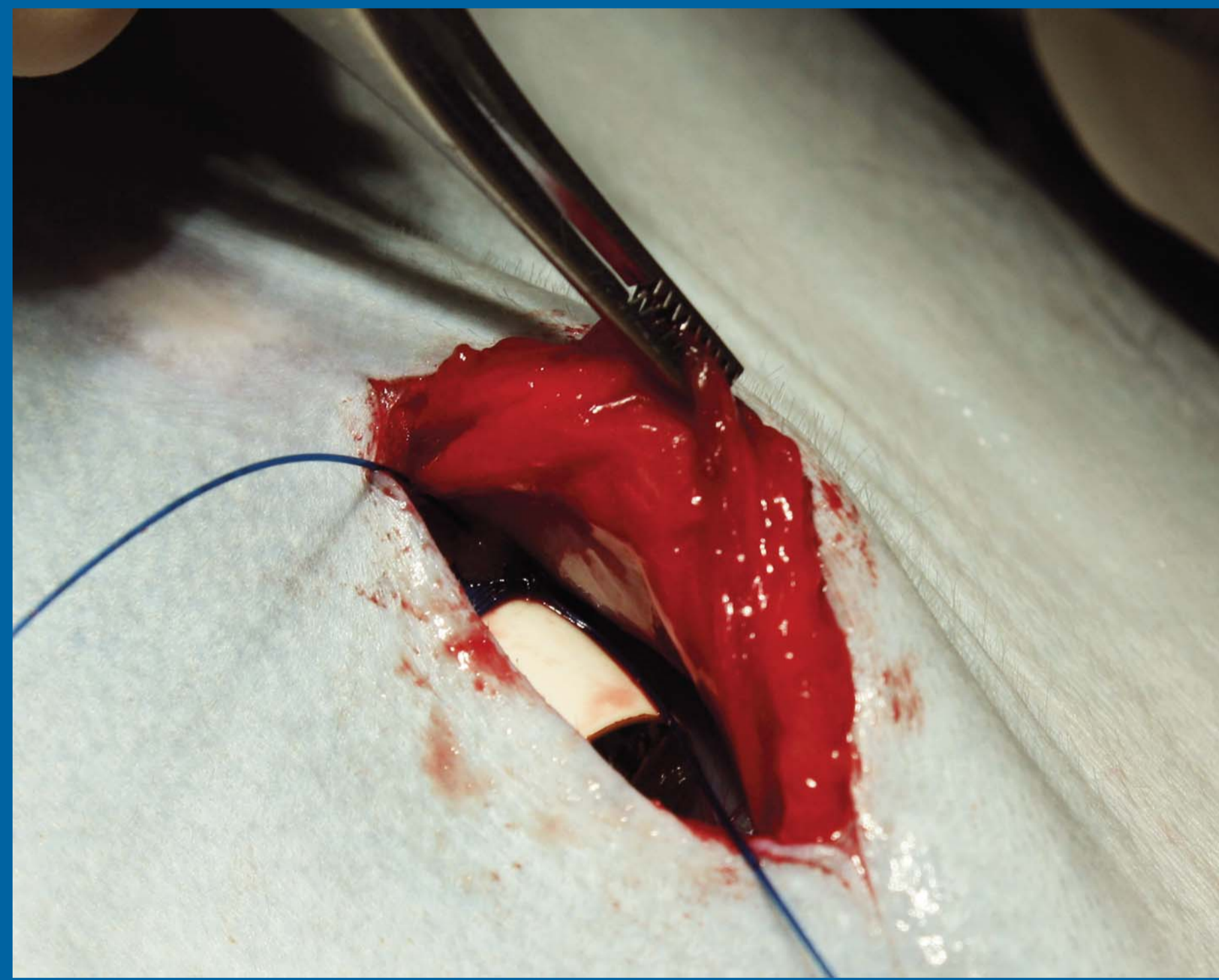


Fig. 3. The pre-op prepared logger was inserted into the abdominal cavity, and the needle was then used to attach the logger to the abdominal wall during linea alba wound closure.



Fig. 4. Abdominal X-ray, lateral view: The logger was inserted into the abdominal cavity, and the needle was then used to attach the logger to the abdominal wall during linea alba wound closure.

### Results

The temperature loggers were removed smoothly from all 12 animals 5 months after insertion. All loggers were still fixed in the position where they had initially been stitched (Fig. 5). The retrieval surgery was scored as a minor discomfort. All measured data was uploaded successfully into a PC (Fig. 6). The implanted loggers did not affect the animal's health, which was checked daily.

### Conclusion

The bled knot around the smooth loggers to attach them to the abdominal wall was seen to be a simple solution to prevent abdominal migration of temperature loggers, and to facilitate their smooth retrieval post-study in macaques. The implanted loggers did not have an adverse affect on the animal's health.

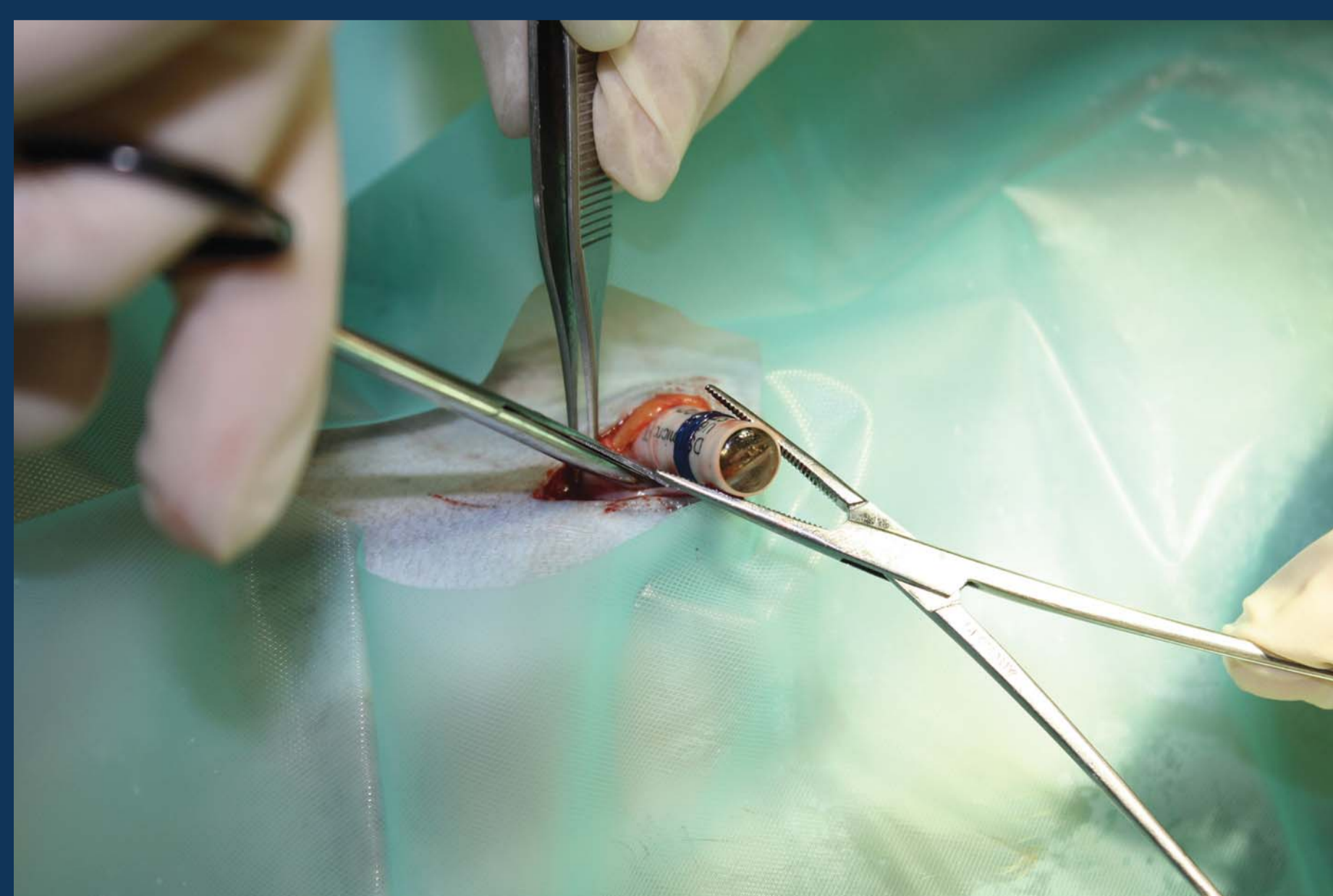


Fig. 5. Minor surgery to retrieve the transmitter.

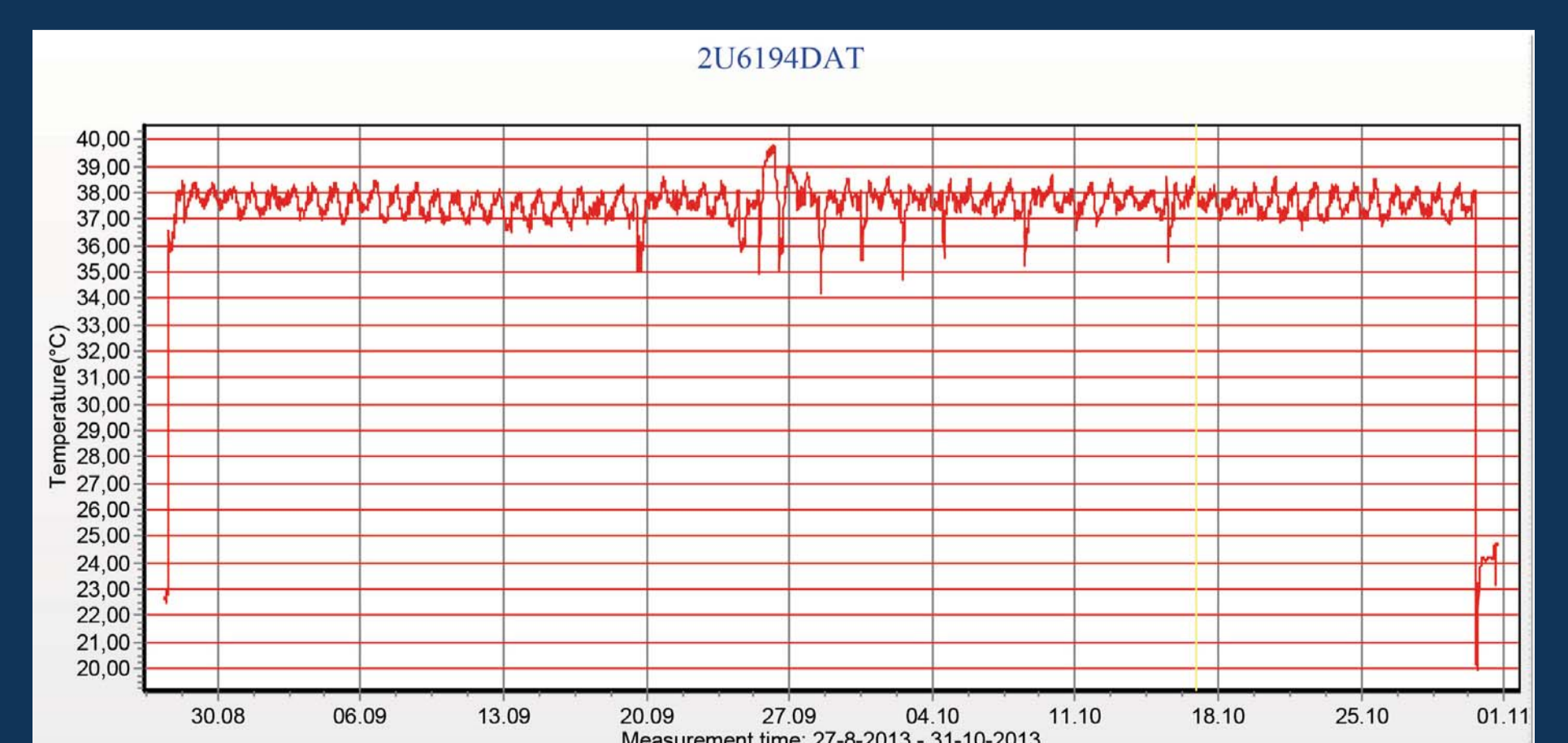


Fig. 6. An example of part of the temperature data collected from an animal during this study. A clear night-day pattern is visible.

### Acknowledgements

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