Design of a Probe-Placement Fixture for Ex Vivo Microwave Ablation Experiments

Product Design Specifications

9/16/2015

Group Members: Mitchell Resch, Tej Patel, Kaitlyn Gabardi, Tyler Davis, Cody Kairis

Advisor: Dr. Beth Meyerand

Client: Dr. Susan Hagness

Function:

Microwave ablation is a type of thermal therapy being used to treat the kidney, bone, liver, and lung cancer. Although this process has worked for these types of cancers, it is currently being researched in hopes of being a successful treatment for other types of cancer. Microwave ablation treatment denatures and destroys cancerous cells by using the heat generated by microwaves. The power of microwaves is delivered to the cells through an antenna, and monitored through small temperature probes. This technique, if proven effective, would be a preferred method for future tumor treatments because it prevents many side effects that traditional treatments pose for many patients.

The goal of this project is to design a fixture for microwave ablation probe placement that can be easily used by researchers during experimentation. In order to test the design, the probe-placement system with be tested using ex vivo tissue from the liver.

Client Requirements:

- Operate quickly and efficiently due to the clients 15 minute time limit with the tissue sample.
- Must be able to easily maneuver and insert the temperature probes and antenna efficiently into the tissue sample.
- The mastectomy sample must remain in good condition after the experiment.
- Each probe has to be equally 0.5 cm apart, and 2 cm from the antenna in parallel. If possible, would like the option to make the distance variable.
- The probes perpendicular from the mastectomy sample, but would like the potential in from different angles is desired if possible.
- Maximum Diameter should be 20 cm to hold all of the temperature probes.

Design Requirements:

1. **Physical and Operational Characteristics**

a. Performance requirements: The device must be able to insert a microwave ablation probe and fiber optic temperature probes into a mastectomy. The device must also be able to position the temperature probes an accurate distance from the ablation probe, while remaining at the proper depth and parallel to the ablation probe.
b. *Safety:* Our device must be functionally stable so it avoids all contact with the tissue. The mastectomy must remain intact and testable after the experiment is completed.
c. *Accuracy and Reliability:* Design must function in a way that it can be used for numerous experiments to provide consistent and accurate results for the research assignment.
d. Life in Service: Probe positioning device must be continuously effective throughout its implementation.
e. Shelf Life: The probe positioning device must last for multiple years.
f. Operating Environment: The device will be operated on a small lab table held at standard atmospheric conditions and temperature. The device will be positioned 10-25 cm above the mastectomy sample during the 15 minute procedure.
g. Ergonomics: The device must be easy to use after a quick briefing. It must also be quickly assembled and disassembled.
h. Size: The probe placement device must be able to fit on a small lab table approximately 120 cm by 120 cm and be no more than 10-25 cm above the mastectomy sample.
i. Weight: The maximum weight of the device should not exceed five kilograms.
j. Materials: The probe fixture must be sterilizable. Have access to sample antennas and fiber-optic probes.
k. Aesthetics, Appearance, and Finish: Aesthetics and appearance of the design is not of particular importance.

2. **Production Characteristics:**

a. Quantity: One fully operational probe-placement fixture will be produced.
b. Target Product Cost: The budget is $150.

3. **Miscellaneous:**

a. Standards and Specifications: No standards or approvals are required.
b. Customer: The research team conducting the experiments must be able to use the device.
c. Patient-related Concerns: The device must be sterilizable.

d. Competition: There are currently no devices in the market that act as a probe placement fixture for microwave ablation.