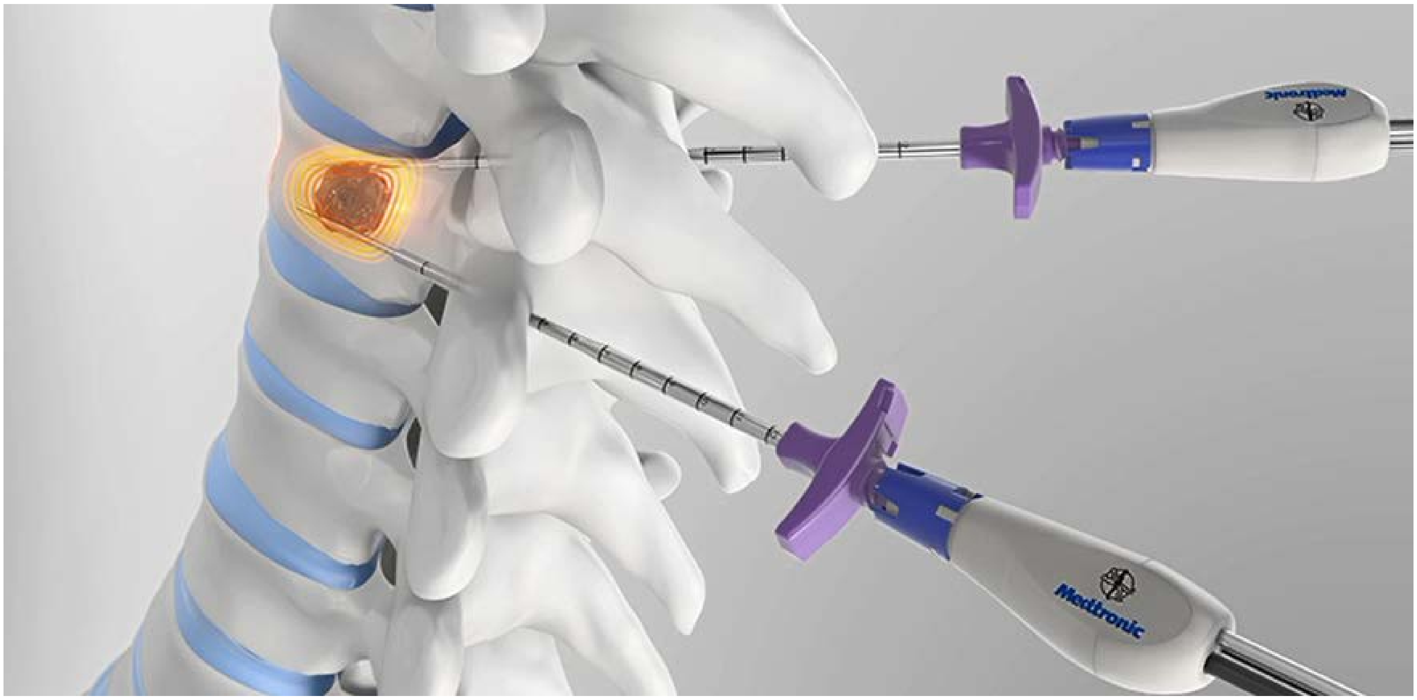
DESIGN CASE STUDY

MEDTRONIC RF ABLATION ANALYSIS



PROJECT DETAILS

Customer: **Medtronic**

Application: **Pain Therapy**

Technology: **RF Ablation Simulation Analysis**

Industry: **Medical Device**

Location: **Milpitas, CA**

Medtronic

THE DESIGN CHALLENGE

One of the most common causes for severe pain in patients with cancer comes from cancer metastases. Once the cancer metastasized, the patients often experience chronic pain or other related effects. Even though radiotherapy and chemotherapy is the standard of care for cancer patients, approximately 25% of those patients do not get pain relief.

This project was an R&D project for Medtronic, Inc. There are currently several treatment options for painful metastatic disease with RF ablation being the most mature treatment option. One of the disadvantages of RF ablation is its reliance on conduction to spread the heat from the ablation probe to the surrounding tissue. This requires subjecting the patient to a long procedure. Interventional radiologists want shorter procedure times with quicker heating rates and higher temperatures while maintaining the safety profile that RF ablation has (spherical, controlled heating zone around the applicator port).

The challenge was to use higher frequency RF waves to deliver focused energy into the tumor at the greatest efficiency thus minimizing the losses at the device-tissue interface and on the transmission line.

> This research is an exciting step in the advancement of pain therapy techniques for cancer patients.

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THE AAVID SOLUTION

The approach taken was to use a multiphysics simulation approach in designing the new RF ablation device. As an electromagnetic wave at high frequency travels through a biological tissue the tissue gets heated (the mechanism of heating can be either ionic heating – indirect - at low frequencies or direct heating at high frequency) at a temperature that is above 40°C and therefore causes cell death. A coupled electromagnetic – heat transfer analysis was conducted on several applicator designs in order to maximize the amount of energy delivered in a certain tissue with a specific impedance range.

The system is temperature controlled and uses internally water-cooled probes to prevent overheating of surrounding tissue during the procedure. The project focused on optimizing not only the applicator geometry but also the upstream RF system in order to minimize overheating of the tissue in direct contact with the applicator. At the same time, the energy delivery algorithm as well as the internal cooling parameters had to be optimized in order to maximize the effect of ionic heating on lesion size.

Using a CMS approach enabled the R&D engineers to explore a multitude of designs in a relatively short period of time and reduced cost. Prototypes were already assembled by the customer and are in the evaluation/feasibility process. The project will most likely continue with choosing several candidates that will be then optimized (one or two candidates at a minimum) and the most promising design will be submitted for design control process approval by the client.

Aavid, Thermal division of Boyd Corporation, helped simulating and optimizing the RF ablation probe design and performed coupled electromagnetic and computational fluid dynamics analysis to validate the experimental results performed on tissue mimic material.

This research is an exciting step in the advancement of pain therapy techniques for cancer patients and Aavid is proud to be part of it.