

## Monopolar Electrosurgical Thermal Management System to Reduce Lateral Thermal Damage During Surgery

**Robert Dodde** and Jacob S. Gee  
*University of Michigan*

James D. Geiger  
*Medical School, University of Michigan*

Albert J. Shih  
*University of Michigan*

A monopolar electrosurgical device is the most commonly used energy-based surgical instrument. Monopolar devices are primarily applied to incise, ablate, dissect, and coagulate tissue by transferring electrical energy to the tissue in the form of heat generation through resistive heating. The substantial amount of heat created by the monopolar device has been shown to spread throughout the tissue, creating unintended tissue damage, which can lead to nerve thermal damage and loss of normal bodily functions. Due to this fact, energy-based devices have had a limited

use in surgical procedures performed near neurovascular bundles. The extent to which the generated heat raises the temperature of the surrounding tissue is referred to as the device's thermal spread. In this study, ex vivo and in vivo experiments have shown that a novel thermal management system (TMS) can reduce the amount of thermal spread created by a typical monopolar device, thus eliminating the thermal collateral tissue damage typically caused during a monopolar procedure. The incorporation of a TMS consisting of adjacent cooling channels reduces the thermal spread of the device, as illustrated in a reduction as high as 50% in the maximum temperature recorded during an in vivo experimental procedure. The design of the TMS was aided by finite element modeling (FEM). The phenomenon of monopolar resistive heating was modeled to analyze the temperature distributions in biological tissue subjected to heat generation by a commonly used monopolar electrosurgical device. The mathematical model was verified by comparing the model's predicted temperature distribution with experimental results. Ex vivo experiments were performed with liver tissue heated by a monopolar pencil electrode. The experimental data for 1 mm distance from the electrode are seen to fit within 1% of the predicted temperature values by the FEM simulation.

## Adult Male Circumcision Tool for Use in Traditional Ceremonies

**Thomas F. Van Wingen** and Kyle A. Lemmermen  
*Department of Mechanical Engineering, University of Michigan*

Craig Spencer, Phil Scott, and Kathleen H. Sienko  
*University of Michigan*

Public health officials are currently supporting adult male circumcision as a public health policy to minimize the transmission of HIV during intercourse. Estimates indicate that more than 3

million lives could be saved in sub-Saharan Africa alone if the procedure becomes widely used. Complications including infection and accidental cutting/amputation of the glans during traditional circumcision ceremonies can lead to permanent injury or death. A low cost, adjustable (one-size-fits-most), culturally appropriate adult male circumcision tool was designed for use in traditional circumcision ceremonies. A surgical procedure for using the device has also been defined, which can be performed in either a clinical or nonclinical setting.