Accepted Manuscript

Identification of cell thermal microenvironment in porcine skin during laser cauterization

S. Bhogle, G. Mistri, B. Vesper, S. Lacey, J. Radosevich, M. Colvard, É. Budyn

PII: S0045-7825(16)31341-X
DOI: http://dx.doi.org/10.1016/j.cma.2016.10.018
Reference: CMA 11179

To appear in: *Comput. Methods Appl. Mech. Engrg.*

Received date : 26 August 2016
received in revised form 27 September 2016
accepted 5 October 2016

Please cite this article as: S. Bhogle, et al., Identification of cell thermal microenvironment in porcine skin during laser cauterization, *Comput. Methods Appl. Mech. Engrg.* (2016), http://dx.doi.org/10.1016/j.cma.2016.10.018

Identification of Cell Thermal Microenvironment in Porcine Skin during Laser Cauterization

S. Bhogle[b], G. Mistri[b], B. Vesper[c], S. Lacey[d], J. Radosevich[c], M. Colvard[c], É. Budyn[a,b,c,*]

[a]*Dpt. of Mech. Eng. - LMT CNRS UMR 8535, ENS Cachan, University Paris-Saclay, 61 Av. Pres. Wilson, 94230, France*
[b]*Dpt. of Mech. Eng., University of Illinois at Chicago, 842 West Taylor Street, Chicago, IL 60607, USA*
[c]*Dpt. of Oral Med. Diagnostic Sci., University of Illinois at Chicago, 801 South Paulina Street, Chicago, IL 60612, USA*
[d]*Dpt. of Environmental Health Sci., Indiana University Fairbanks School of Public Health, 714 North Senate Ave, Indianapolis, IN 46202, USA*

Abstract

In order to minimize bleeding during surgical intervention, laser devices make it possible to produce local heat for cauterization and to reduce the blood loss at the site of the incision in the skin. However, the method is sometimes associated with local overheating and tissue partial vaporization. We present a 3D Finite Element Model (FEM) hierarchical model to simulate the effect of heat produced by different surgical laser devices on the skin. The model includes the macro-molecular, cell and tissue scales. The model follows the bio-heat equation where the transient heat diffusion includes heat conduction in the tissue, convection with the surrounding air, the metabolic heat and the heat source of the laser device. The laser heat flow propagating in the skin was assumed to exponentially decrease from the opening edge of the wound. A set of different lasers were tested on live porcine skin under general anesthesia. The skin morphology of harvested samples along the wound was digitally surveyed in light microscopy observations of the skin specimens that had been previously stained with an anti-swine antibody. The biological constituents of the skin tissue were modeled as separate continua of specific thermal properties taken

*É. Budyn
Email address: ebudyn@uic.edu (É. Budyn)