Correlation of Optical Coherence Tomographic and Histologic Appearance of Artifacts cause by Surgical Instrumentation during Tumor Resection


Department of Veterinary Clinical Medicine, University of Illinois at Urbana-Champaign
Department of Electrical, Computer Engineering, and Bioengineering, University of Illinois at Urbana-Champaign

Introduction

Optical coherence tomography (OCT) has been reported for intraoperative surgical margin assessment in human breast cancer and canine soft tissue sarcoma surgery. OCT provides high resolution imaging of microscopic tissue in real-time to allow for surgical margin assessment. The use of common surgical instrumentation carries the risk of causing microscopic tissue damage that may alter the appearance of tissues by OCT imaging. To date, there has been no investigation of the OCT imaging appearance of surgical artifacts. These artifacts must be recognized during the evaluation process to increase the sensitivity and specificity of cancer margin imaging. The objective of this study was to correlate the OCT imaging with histologic appearance of artifacts caused by common surgical instrumentation in different tissues at surgical margins.

Materials and Methods

Skin, subcutaneous fat, muscle, and fascial samples were utilized from fresh canine cadavers. The areas were prepared for artifact infliction and subsequently histologically processed. OCT images were directly compared to histopathology sections to formulate a training set.

Results

- **Blood staining**: created high scattering at the tissue surface and reduction in the depth of penetration (Figure 1); lost during tissue processing for histopathology.
- **Crushing injury**: created irregular, scalloped appearance to the tissue surface with focal, high-scattering regions (Figure 2).
- **Scalpel blade**: created focal, low-scattering regions (Figures 3 A,B).
- **Monopolar electrosurgery**: created a highly irregular tissue margin with multifocal high-scattering regions becoming brighter with increasing power (Figures 4 A,B).
- **LigaSure™**: created a contiguous low-scattering region at the tissue surface with an underlying moderate scattering region (Figure 5).
- **Harmonic scalpel**: created a coarse, undulating appearance to the tissue margin.

Discussion

The surgical instrumentation used in this study resulted in the production of appreciable microscopic imaging changes which could be characterized with OCT imaging. Notably, more significant changes were seen with the use of higher power monopolar electrosurgery and LigaSure™. Knowledge of the appearance of tissues following the use of different commonly used surgical instrumentation is essential to help increase the diagnostic accuracy of surgical margin assessment and guided pathologic interrogation for both canine and human cancer margin evaluation.

References