# Raman Laser Damage Threshold of Rat Pial Cortex

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CNS 2017 ANNUAL MEETING BOSTON, MASSACHUSETTS OCTOBER 7–11, 2017

## Introduction

Raman spectroscopy is a tool that utilizes a label-free modality of optical imaging that measures scattered photon shifts to give a unique biochemical signature. Its diagnostic capabilities are currently being explored including its applications to intraoperatively identify tissue and oncologic surgical margins. There is great potential in a tool that allows simultaneous diagnosis and surgical guidance, however no previous studies have shown its safety and threshold at which it causes damage to cortical grey matter. The goal of the present study assessed the threshold at which a 785nm raman laser damages rat pial cortex.

## Methods

Sprague Dawley Rats were anesthetized with a ketamine/xylazine cocktail and placed in a stereotaxic frame with an integrated laser optical setup. After a craniotomy and durotomy was made, the pial surface was exposed to 10, 20 or 60 seconds of a 785nM raman laser at 100mW. Initial experiments failed to show any damage, and the laser was maximally increased to 180mW and exposure time increased to 15 minutes. Animals were then sacrificed immediately and processed for H&E, NFAP, and GFAP staining to determine the depth/spread of the injury.

## Results

A neuropathologist examined all slides and did not detect any H&E changes on sham brains or on any pilot experiments, thus the laser power was increased to 180mW and exposure time to 15 minutes. Even at the increased power and exposure time, there were no pathological signs of damage.

**Figure 1. H&E stained cross section of rat pial surface after raman laser exposure**

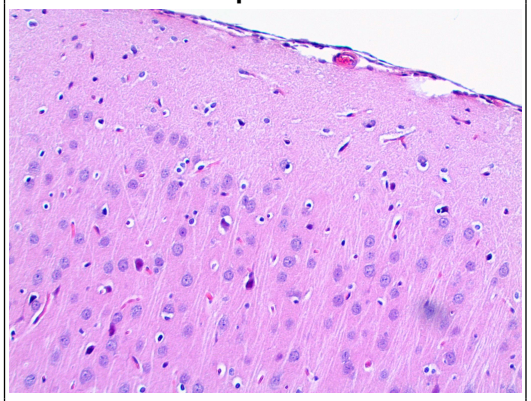

Figure 1. H&E staining of rat pial cortical surface after exposure to a 180mW 785nm raman laser for 15 minutes. There are no obvious signs of disruption or damage.

**Figure 2. GFAP stained cross section of rat pial surface after raman laser exposure**

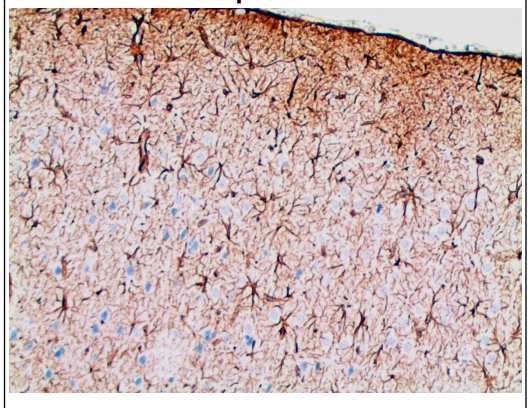

Figure 2. GFAP staining of rat pial surface after exposure to a 180mW 785nm raman laser for 15 minutes. There are no obvious signs of disruption of damage.

## Conclusions

A 785nM 180mW raman laser does not cause thermal damage to the rat pial cortical surface even with 15 minutes of exposure time. Further studies are needed at higher laser powers and increasing survival times to observe delayed changes that may be detected by stains such as NFAP, GFAP and myelin staining such as luxol blue.

**Figure 3. NFAP stained cross section of rat pial surface after raman laser exposure**

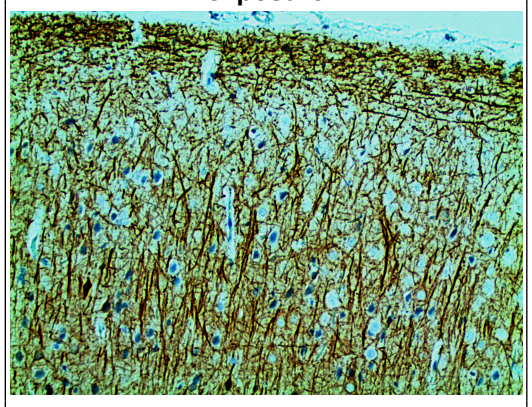

Figure 3. NFAP staining of rat pial cortical surface after exposure to a 180mW 785 nm raman laser for 15 minutes. There are no obvious signs of disruption of damage.

## Learning Objectives

1)Physics and diagnostic applications of raman spectroscopy

2)Safety of a 785nM raman laser on cortical brain

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