Developing a Deep Learning Convolutional Neural Network Method to Detect Non-Human Primate Skin Lesions

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1 INTRODUCTION

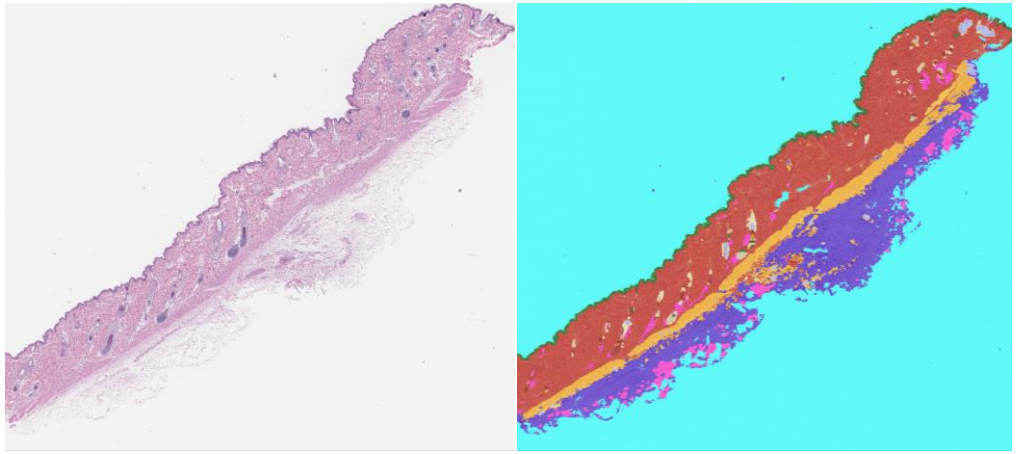
- Non-human primates are an important animal model in assessing skin injury after local administration of xenobiotics
- Currently histologic scoring methods are used in evaluation of skin to evaluate reactions like delayed type hypersensitivity (DTH)
- Scoring methods are qualitative, subjective, and prone to inter- and intra-study variability
- **Hypothesis: A deep learning method using a convolutional neural network (CNN) will facilitate skin lesion detection and scoring for the toxicologic pathologist**

Deep Learning model serves as **effective decision support tool** for detecting normal structures and key degenerative and inflammatory lesions in skin.

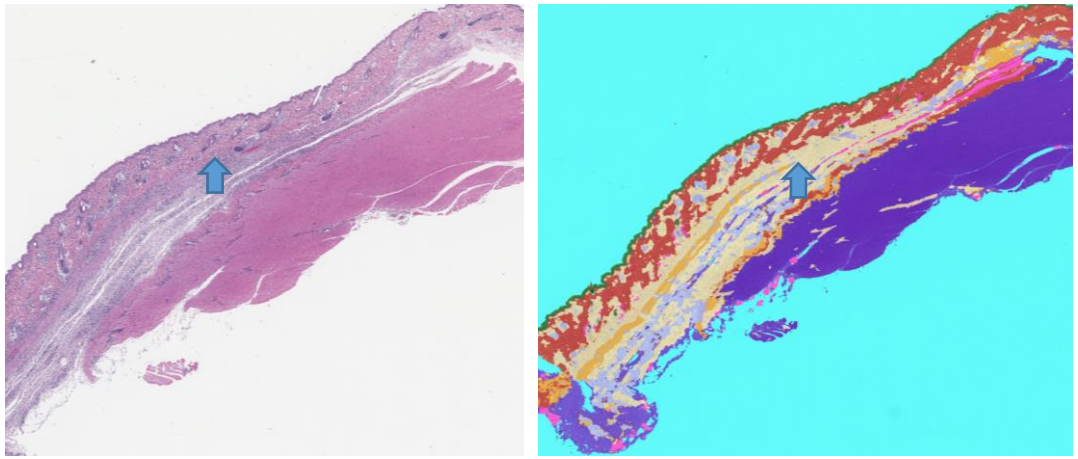
3 DISCUSSION

- CNN trained to identify normal skin structures and four classes of skin lesions in non-human primate (Figure 1 and 2):
  1. Epidermal hyperplasia
  2. Epidermal erosion/ulceration
  3. Dermal and subcutaneous inflammation/infiltrate
  4. Panniculus and muscle myodegeneration/necrosis
- Model performance with original training annotations achieved F1 score of at least 0.7 for lesion classes (erosion/ulceration, inflammation, myodegeneration) (Figure 3)
- Additional qualification with samples from original study and new studies underway
- Qualification data suggest that the CNN model will be an effective decision support tool for the pathologist
- **Reference:** Bouchez, C et al. "Development of a Delayed-Type Hypersensitivity (DTH) Model in the Cynomolgus Monkey." *Toxicology letters* 205 (2011): S146–S147

2 DATA



Skin from vehicle control group. Matched H&E digital section with AI DL masks from trained model. (Fig. 1)



Skin from positive control group. Matched H&E digital section with AI DL masks from trained model. Note the loss of continuous panniculus muscle (arrow) and replacement by chronic active inflammation. (Fig. 2)

	f1
Background	0.94
Myodegeneration/Necrosis	0.94
Muscle	0.89
Infiltrate/Inflammation	0.87
Panniculus	0.83
Subcutis /Adipose	0.82
Erosion/Ulceration	0.81
Epidermis	0.78
Dermis	0.74
Hyperplasia/Hyperkeratosis	0.00

Classifier F1 Scores (Fig. 3)

AI Mask Key:
Green: Epidermis; **Red:** Connective Tissue; **Yellow:** Panniculus; **Pale Yellow:** Inflammation; **Pale Blue:** Myodegeneration; **Purple:** Muscle; **Pink:** Subcutis/Adipose