

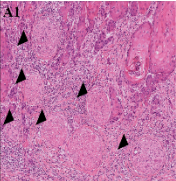
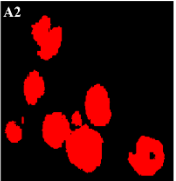
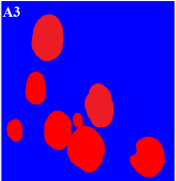
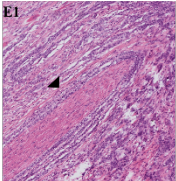
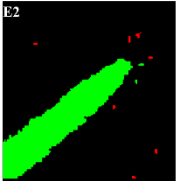
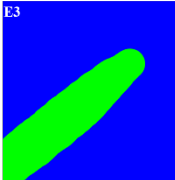
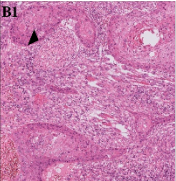
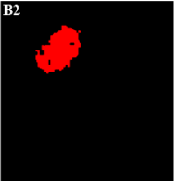
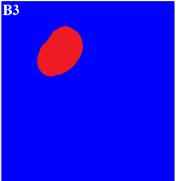
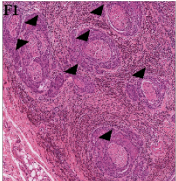
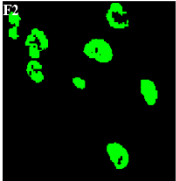
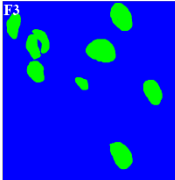
## Precision diagnosis of nerve invasion in oral cancer with Domain-KEY AI model

Frontiers in Oncology 2022 Oct. 24 <https://www.frontiersin.org/articles/10.3389/fonc.2022.951560/full>

Perineural invasion (PNI) is an important risk factor regarding tumor control and survival rate post oral cancer surgery. Clinical variation in PNI diagnosis among pathologists is a challenging task. Here CGMH researchers develop an innovative deep learning-based domain knowledge enhanced yield (Domain-KEY) AI algorithm coupled with MetaLite software to facilitate digital pathology diagnosis of PNI.

With H&E-stained whole slide images (WSIs) of 80 patients with oral squamous cell carcinoma, two semantic segmentation models were established for nerve fiber recognition and neural invasion detection. Then 10 independent WSIs were selected to be read and marked by the Domain-KEY algorithm, and finally validated by two pathologists. The diagnostic accuracy of WSI with Domain-KEY algorithm was as high as 98%, superior to traditional classifiers in detecting PNI. Further validation with WSI of 25 patients with oropharyngeal cancer and hypopharyngeal cancer also reached high accuracy of 96%, showing wide applicability of the new methodology.

The Domain-KEY algorithm aids WSI-based PNI analysis with significantly shortened time required for pathological diagnosis (15%-24%), which fulfills huge unmet clinical need. Taken together, it successfully imitates human decision-making skills, optimizes the algorithm development process to generate an AI model with high accuracy based on small training data for routine diagnosis of PNI by pathologists. Such rule-based training methodologies are expected to be beneficial to characterize vascular and lymphatic invasion of various solid cancers with precision diagnosis.

Original image	Model inference	Ground truth	Original image	Model inference	Ground truth
					
Arrowhead: tumor focally touching the perineurium			Arrowhead: tumor surrounding the entire nerve		
					
Arrowhead: tumor focally touching the perineurium			Arrowhead: tumor surrounding entire nerve and focally touching perineurium		
<b>WSI-based PNI Model (Accuracy)</b> Oral cancer SCC: <b>98%</b> Oropharyngeal cancer: <b>96%</b> Hypopharyngeal cancer: <b>96%</b>			<b>WSI Diagnosis Time (Reduction)</b> for Pathologists: <b>15%~24%</b>		

### Rule-based Deep Learning Gives High Accuracy with Small Dataset

SCC: squamous cell carcinoma; WSI: whole slide image